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Developmental Methodologies for Medium- to Long-Range Estimates

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DEVELOPMENTAL METHODOLOGIES
FOR MEDIUM- TO LONG-RANGE ESTIMATES

Interim Technical Report

June 1976

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This report describes the equalization of four regional forecasting models (Europe, Middle East, Latin America, and Africa), the research involved in enriching the models to include the capability to simulate the impact of superpower behavior on the region and government change, and the development of a preprocessing control module for the current long-range forecasting program that will make the models user-interactive.

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PREFACE

This Interim Technical Report describes the research activities undertaken during Tasks 1 and 2 of ARPA-supported contract number MDA903-76-C-0255 entitled "Developmental Methodologies for Medium- to Long-Range Estimates." The report elaborates the theoretical, empirical, substantive, and methodological aspects of the first two phases of this project.

Chapter 1 is by far the most complex and detailed chapter in the report. It reviews the existing JCS/J-5 family of models, identifies areas where the CACI research staff felt improvements in each could be made, presents specifications of all improved forecasting equations, and presents the results of all empirical tests performed so far. Chapter 2 focuses on the two innovations that enrich this third generation model, namely, the addition of China to the superpower influence set and the introduction of the capability to stimulate the impact of government change.

Chapter 3 deals with the technical aspects of the interactive program development and provides the logical structure on which this important advance is based. Chapter 4 treats Soviet force effectiveness, focusing on the conceptual and methodological requirements for modeling Soviet force effectiveness and presenting accomplishments in developing the interactive computer program to allow analysts to produce measures of total Soviet force effectiveness.

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EXECUTIVE SUMMARY

This Interim Technical Report describes CACI's progress to date on Defense Advanced Research Projects Agency (ARPA) contract number MDA903-76-C-0255. The research, which began in March 1976, will improve the capability of the Defense Intelligence Agency/Directorate for Estimates (DIA/DE) to forecast important factors that define the international military environment and have implications for long-range, national intelligence estimates.

This project, "Developmental Methodologies for Medium- to Long-Range Estimates," represents the fourth phase of CACI's development of new technologies to enhance forecasting capabilities within the Department of Defense (CACI, 1975b, 1974, 1973). Each effort has improved the long-range forecasting capability within the national security community by applying social science research methodologies to long-range forecasting of important economic, political, military, and social variables. Furthermore, each effort has generated technological innovations that enhance the reliability, accuracy, relevance, timeliness, and hence the credibility of long-range forecasting for defense policy and planning.

The current project has four objectives:

1. Refining and equalizing forecasting models developed for Europe, Latin America, sub-Saharan Africa, and the Middle East, previously developed under contracts DAHC-15-71-C-0201 and MDA903-75-C-0179 for the Joint Chiefs of Staff (JCS/J-5).

2. Enriching the existing models by including the People's Republic of China (PRC) as a major actor in the superpower simulation capability and adding the option to simulate the impact of political regime changes.

3. Developing a model to project future Soviet force effectiveness, based on the Defense Intelligence

Projections for Planning (DIPP), including the capacity of the Soviet Union to improve the quality and quantity of its major weapons systems and pose increased threats to U.S. interests.

4. Implementing both the improved forecasting models and the Soviet force effectiveness model on the Defense Intelligence Agency On-Line System (DIAOLS) with a user-interaction capability to permit DIA analysts to forecast alternative futures by altering data, superpower behavior, or regime types, and/or forecast parameters by simulating different conditions and/or assumptions.

PROGRESS TO DATE

This Interim Technical Report describes research activities undertaken to complete project Tasks 1 and 2.

Task 1. Further Develop, Equalize, and Adjust International Region Projection Models

Four subtasks are subsumed under Task 1.

Subtask 1-A. Update the European forecasting model to the level of sophistication of models for Latin America, Africa, and the Middle East by increasing model complexity and collecting new data.

Subtask 1-B. Add the People's Republic of China to the potential influence set that currently includes the United States and the Soviet Union.

Subtask 1-C. Develop submodels linking the impact of changes in national leadership orientation to the current long-range forecasting models for Europe, the Middle East, Latin America, and Africa.

Subtask 1-D. Adjust the existing programs to permit direct user interaction and simulation of alternative futures through on-line alteration of data files and parameters.

Task 2. Develop Total Soviet Force Effectiveness Model

Two subtasks are subsumed under Task 2.

Subtask 2-A. Review approaches to assessing Soviet total force effectiveness using information produced in the Defense Intelligence Projections for Planning On-Line System (DIPPOLS) and select the best method for building a force effectiveness model.

Subtask 2-B. Develop an interactive computer system allowing DIA analysts, using information from the DIPP, to produce measures of total Soviet force effectiveness.

In completing Tasks 1 and 2 CACI has

- Carefully reviewed the forecasting models for Europe, the Middle East, Latin America, and Africa, and
  - Examined each forecasting equation both from a substantive and a statistical perspective;
  - Specified, whenever necessary, new equations for any region;
  - Identified and collected the necessary data to evaluate new equations;
  - Improved the presentation of forecast variables such as those describing international economic and political alignment.
- Upgraded the European model to the complexity of the more recently generated, less-developed regional models by
  - Identifying and collecting appropriate data to reestimate region-specific parameters for equations commensurate with those for the Middle East, Latin America, and Africa;
  - Identifying and collecting time-series data to generate country-specific economic parameters on investment, consumption, imports, exports, and domestic product;
  - Adjusting the rival defense spending in the less-developed regional model to reflect the importance of the European military alliances to that region;

- Structuring the revised equations into an interactive forecasting model for the European region.

- Added the People's Republic of China to the set of superpowers by

  - Identifying the quantifiable major dimensions of Chinese foreign policy and behavior;
  - Specifying equations to be tested for each region in which the People's Republic of China has shown interest;
  - Assembled data on PRC trade, aid, military aid, and cooperation for parameter estimation.

- Improved the existing regime change mechanism to give DIA analysts flexibility to simulate regime changes by

  - Refining and increasing the number of government types from three to five;
  - Identifying a specific subset of equations empirically demonstrated to react to regime change;
  - Generating alternative parameter sets for each regime type to replace existing parameters when a government change is simulated.

- Developed a user-interactive capability by

  - Constructing a main control program to guide the analysts through the forecasting models;
  - Constructing a "preprocessor" to control access to data, parameters, superpower behaviors, regime change parameters;
  - Altering the existing forecasting program structure to include the European region, Chinese influence, and the regime change module, and to accommodate changes in the basic forecasting equations and the presentation of actual forecast output.

- Reviewed approaches to measuring Soviet force effectiveness and, in consultation with DIA/DE,

  - Determined concepts relevant to evaluating Soviet force effectiveness such as lethality, accuracy, and survivability;
  - Identified DIPP and DIPPOLS components relevant to calculating Soviet force effectiveness;

- Specified methods for aggregating DIPPOLS data into meaningful combinations for presenting and forecasting Soviet force effectiveness.

- Began structuring an interactive computer program to produce measures of total Soviet force effectiveness from existing DIPP files.

These technological innovations advance considerably the long-range forecasting and simulation capability currently available to the national security community. Once completed, the regional forecasting/simulation models will permit defense analysts to evaluate different assumptions about improving or deteriorating national and international conditions, improving or deteriorating relations between a specific country and the United States, the Soviet Union, or China, or the increasing or decreasing influence of any predictor variable or variables in the forecasting model. Finally, upon completion analysts will be able to assess how well-equipped the Soviet Union is to handle certain projected international environments given projected force levels and structures.

Having completed most of the model restructuring and interactive programming, CACI's immediate concern is to implement the interactive portion of the long-range forecasting model on DIA's Honeywell 365 to evaluate its logic and to develop, in consultation with the contract monitor, additional sections to facilitate use of the forecasting/simulation model. Simultaneously, CACI will continue to develop its Soviet force effectiveness model and its linkages to the international regional forecasting models.

CHAPTER 1. EQUALIZING THE LONG-RANGE FORECASTING MODELS

This chapter describes the research strategy for equalizing the long-range forecasting models developed by CACI for the Joint Chiefs of Staff (JCS)/J-5, Long-Range Branch (CACI, 1974, 1975a, 1975b) under two separate projects supported by the Defense Advanced Research Projects Agency (ARPA). The first project, focusing on Europe, produced a model to generate long-range forecasts of national economic and military power base, international trade, international alignment, international conflict, and domestic instability. The second project produced more elaborate forecasting for Africa, Latin America, and the Middle East.

Because the countries modeled in the two projects differ considerably, and because important research and development advances were made in the first project that permitted further advancement in the second, the two generations of forecasting models differ greatly. Relatively simpler structures for Europe were expanded to more complex models for Africa, Latin America, and the Middle East. Region-specific forecasting parameters for Europe were supplemented with region- and country-specific parameters for the less-developed regions. More output variables are forecast for the African, Latin American, and Middle Eastern models, and an initial simulation capability was also added for these regions.

The current effort standardizes or equalizes the model structure, input and output variables, forecasting equations, and simulation capability across all the models. This chapter discusses the research necessary to equalize the complexity of the models for all the regions. Hence, it presents efforts that included

- Reviewing the European and less-developed region models for substantive empirical similarities;
- Standardizing theoretical equations for which parameters would be generated;

- Collecting necessary data and estimating forecasting parameters; and
- Assembling the newly tested forecasting equations, equalized across all four regions, into a new long-range forecasting model.

The chapter is arranged by model sector beginning with domestic economics, followed by a discussion of the international economic sector. Economic and military alignment are then treated, followed by international political alignment. The last three sections focus on military power base, and domestic and international violence. Each section focuses on the forecasting equations describing a particular sector. Each sector is discussed from both theoretical and empirical perspectives. Past research findings that guided specification of the initial, theoretical forecasting equations are discussed and summarized in a table on the hypothetical relationships among variables for the specific regions. The research findings generated through tests of these relationships (derived from the regression analyses) are then presented. The resulting parameters are used in the forecasting model discussed in this report.

THE ECONOMIC SECTOR

Theoretical Considerations

Two quite different approaches to depicting the economic sectors are found in the current JCS/J-5 long-range forecasting models. The simplest perspective is presented in the European region model (CACI, 1974) where the economy is not disaggregated but only considered as gross domestic product (GDP). Values on current GDP, in turn, are predicted from prior GDP values. No effort is made to predict the various components of GDP. Contrasted with this is the much more complex approach used in the models for Africa, Latin America, and the Middle East, which attempts to forecast both aggregate national output (GDP) and its various components (investment, consumption, trade) as a classic Keynesian, demand-driven system. A series of predictors of the components of GDP are employed in this approach and

the GDP is then computed as an identity (where GDP = consumption + investment + exports - imports).[1]

While the more complex economic sectors for the less-developed regions permitted country-specific parameters to be developed, they also created numerous parameter estimation problems and limited gain in the accuracy of the results. Moreover, recent CACI (1976a, 1976b, 1976c) research on the economies of the members of the Organization of Petroleum Exporting Countries (OPEC) determined that the behavior of economic sectors, even in countries that have had substantially expanded revenues, could be predicted with relatively simple forecasting equations. Hence, suitably accurate, simpler country-specific estimation procedures (combining the best of the two existing approaches) were used in the current version of the model.

Table 1 presents the hypothesized structure of the economic sector for the new equalized model that is estimated for all regions.[2] It describes a simplified economic sector that is assumed to produce accurate forecasts for each country. The economic sector presented in the table is based on lagged, autoregressive, time-series analysis. The parameters generated from such analyses are compound growth rates that describe the historical rate of expansion for the economy.[3] Each of the equations identified in Table 1 can be algebraically expressed as

$$y_t = \alpha + \beta y_{t-1} + \varepsilon$$

---

[1] An elaborate discussion of this sector for Europe is found in CACI (1974). The sector is discussed for Africa, Latin America, and the Middle East in CACI (1975a). The discussion in that report focuses on CACI's assessment of the economic sector model in the model for the less-developed regions.

[2] Appendix A lists all countries included in the four regions.

[3] Two separate, lagged autoregression analyses were done for all 90 countries. First, the dependent time series was regressed onto a lagged time series of the same variable (autoregression). In every regression, change in gross domestic product (ΔGDP) was also entered. Second, these regression analyses were repeated without the change variable. Since the impact of ΔGDP was negligible, this alternative was discarded.

TABLE 1

Theoretical Equations for the Economic Sector for All Regions

Equation Number	Forecast Variables	Predictor Variables[c]									
		LPOP[b]	ΔGDP	ACONS[d]	AINV[d]	ATIM[d]	ATEX[d]	CONS	INV	TIM	TEX
1	POP	X									
2	CONS		X	X							
3	INV		X		X						
4	TIM		X			X					
5	TEX						X				
6	GDP[a]							X	X	X	X
7	TRDTOT[a]									X	X

[a] This is an identity equation. The dependent variables are arithmetic combinations of the predictor variables (for example, GDP = CONS + INV + TEX - TIM).

[b] In all tables, variables preceded by an "L" indicate a time lag of 1 year, so that LCONS = $CONS_{t-1}$ (that is, consumption for the previous year). A summation sign (Σ) indicates the addition of 5 years of nation data for the variable. A delta (Δ) indicates change over two time periods, for example $\Delta GDP = GDP_t - GDP_{t-1}$.

[c] See Appendix B for variable definitions, years, and sources.

[d] These are autoregressive equations using lagged time-series data.

where y_t is a time series of an economic variable, and y_{t-1} is a lagged value of the same variable.[4] This form is precisely that required for the ordinary least squares (OLS) estimation.[5]

Simplifying the model so that it is based on lagged behavior accomplishes several goals. First, the lagged model parameters smooth the rather wild fluctuations that characterized less-developed economies during the late 1960's. Thus, the resulting growth rates more accurately reflect economic growth.[6] In the more economically stable European region, a parsimonicus economic sector means that the forecasts are based on accurate growth rates that ensure more precise projections.

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[4] This form is linear, but nonlinear formulations are equally reasonable. What is most important from the forecaster's viewpoint, however, is the ability to interpret the forecasts. Using unnecessary transformations to increase explained variance produces output that is more difficult to translate into real world observation.

[5] Although this form is the simplest kind of growth equation, a compound growth form is also appropriate for specifying growth parameters. The compound growth formula gives an average growth rate for a variable based on the first and last years of a time series.

$$Y_t = Y_o (1 + r)^n$$

Where:

Y_o = initial value of y,
Y_t = final value of C,
r = annual compound growth rate, and
n = number of time periods between Y_o and Y_t

[6] The late 1960's and early 1970's were periods of great uncertainty for the international economic system. Both commodity prices and national currency exchange rates suffered greatly from market uncertainties and inflation. Economic downturns in the United States during the 1970's only exacerbated these problems.

Although the new submodel sacrifices complexity, it also aids overall forecast stability in other sectors. Because the economic submodel influences several other sectors of the model, incorrect, exaggerated, or depressed economic projections help to produce inaccurate forecasts in the other parts of the model. By simplifying the economic submodel, greater stability is assured for all forecasts. Additionally, using parameters that reflect a country's past growth captures many intrinsic forces operating in a particular country. While the model assumes that future growth will follow historical trends,[7] the analyst is forced to think in terms of past performance or annual growth rather than about a large number of complex (and often needlessly confusing) relationships.

Finally, reducing the complexity of the economic sector balances the influence of all model sectors move evenly. Simplifying the economic sector eliminates compounding data error, which is a particular problem in the less-developed regions (CACI, 1975a: 33-43), as the model cycles through 20 years of forecasts. In a model with numerous interactive relationships, data error is circulated throughout the system of equations. Error grows with the data and the forecasts become increasingly problematic over time. Thus, the fewer linkages that the model has, that is, the simpler and more parsimonious its structure, the less tendency there is for error to be compounded.

Research Findings

Appendix C, Tables 1-6 present the regional and country specific parameters for imports, exports, consumption, and investment. The first

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[7] Note that the nature of empirical relationships described by statistical information subjected to quantitative analysis is discussed here. These analyses are used to (1) structure the forecasting model, (2) set initial forecasting parameters, and (3) identify base year data for forecasting. With the capability to simulate alternative futures, both data and parameters can be changed. Therefore, this assumption can be tested when parameters or data in the economic submodel are altered.

two tables display the regional parameters for imports and exports. Table 3 presents the growth parameters for both of these variables for each of the individual countries covered in this research. The fourth and fifth tables are composed of the regional parameters for consumption and investment, while Table 6 gives these same data for specific countries.

The time series covered for the countries vary greatly. Although an attempt was made to gather data from 1955-1970 for each, this proved impossible for some countries in the less developed regions. Hence, variations from the 1955-1970 time series are noted on the appropriate tables in Appendix C. Additionally, data were collected in current U.S. dollars, meaning that the historical inflation rate is built into the measure. Thus, the figures presented on Tables 1-6 are growth in selected economic variables including expansion due to inflation. Given the 20 year forecasts that are to be produced from these data, including the historical inflation rate seemed more realistic than computations for 90 countries based on constant U.S. dollars.

Examination of Tables 1 and 2 indicates that the four regions averaged between 8 and 12 percent growth in imports and between 4 and 17 percent growth in exports over the periods covered. Latin America (with 12 percent growth in exports) had the largest growth in each category. Africa and Latin America imported from 2 to 8 percent more than they exported, contributing to the collective balance of trade deficit for countries in these regions. Europe and the Middle East exported from 2 to 7 percent more than they imported, creating a healthy regional balance of trade surplus. Countries within each of the regions varied greatly, however, as Table 3 demonstrates.

Tables 4 and 5 document the growth of consumption and investment in the four regions. Growth in investment varies from a regional high of 12 percent (for Africa) to a regional low of 9 percent (for Europe). Consumption ranges from 7 percent growth in Europe and the Middle East to

11 percent growth in Latin America. In all regions but Latin America, the regional average growth for investment exceeds average regional growth for consumption. In Africa and the Middle East investment exceeds consumption by 4 percent, thereby laying the foundation for sustained economic growth and development. Latin America has a 1 percent deficit, however, as consumption exceeds investment. When combined with the most severe of the regional average trade deficits, the prospects for controlled economic development in Latin America appear particularly bleak if historical growth patterns persist. Again, as with imports and exports, Table 5 shows considerable variation across each region for the growth of investment and consumption.

INTERNATIONAL ECONOMIC INVOLVEMENT SECTOR

Theoretical Considerations

Table 2 represents the hypothesized forecasting equations for a nation's international economic involvement with the United States, the Soviet Union, and China. In all instances, the equations follow the same general form as the imports from and exports to each superpower, respectively, are a function of the wealth (GDP) of the country and the superpower, the population (POP) of the country and the superpower, and the U.N. voting alignment of the country with the superpower (VOTθUS, VOTθSU, VOTθCH). Each superpower is considered separately.

Each of these equations is predicated on findings from analysis done on 65 less-developed nations (CACI, 1975a, 1975b)[8] that consistently revealed the influence of both exporter and importer economics and population on

[8] These were regional time-series analyses in which the dependent variable consisted of the imports or exports of all countries in a region from 1960 to 1970. The independent variables were arranged in the same form. When the dependent variable is regressed onto the four independent measures, parameters on the extent to which change in the independent variables produce change in the dependent are generated.

TABLE 2

Theoretical Equations: International Economic Involvement for All Regions

Equation Number	Forecast Variables[a]	Predictor Variables[b]															
		TIMUS	TEXUS	USGNP	GDP_i	USPOP	POP_i	SUGNP	SUPOP	CHGNP	CHPOP	TIMSU	TEXSU	TIMCH	TEXCH	VOTeUS	VOTeSU	VOTeCH
11	TIMUS			X	X	X	X									X		
12	TEXUS			X	X	X	X									X		
13	TRADUS[a]	X	X															
14	TIMSU				X		X	X	X								X	
15	TEXSU				X		X	X	X								X	
16	TRADSU[a]											X	X					
17	TIMCH				X		X			X	X							X
18	TEXCH				X		X			X	X							X
19	TRADCH[a]													X	X			

[a] This is an identity equation. The dependent variables are arithmetic combinations of the predicter variables (for example, GDP = CONS + INV + TEX - TIM).

[b] See Appendix B for variable definitions, years, and sources.

dyadic (i-j, j-i) trade. In essence, this empirical evidence reveals the interdependence among the GDP and population of exporters and importers in international economics.

Because each equation that forecasts over time, dyadic trade between, individual nations and one of the three superpowers contains GDP_j and POP_j, it is necessary to project these variables as well. Thus, separate forecasting equations of U.S., Soviet, and Chinese gross national products (GNP) and population -- designated as USGNP, USPOP, SUGNP, SUPOP, CHGNP, CHPOP -- must be specified. Based on previous findings (CACI, 1975b) these equations include the prior value of the variable and a fixed growth rate (c).[9]

$$(1) \quad GNP_j = (1 + c)\ GNP_j$$

$$(2) \quad POP_j = (1 + c)\ POP_j$$

Both of these equations establish a linear extrapolation of each superpower's gross national product and population into the future.

Research Findings

OLS regression analysis was used to estimate parameters for each nation's trade involvement with the United States, the Soviet Union, and China. To ensure more stable parameters, the data were arranged in time series by region. A region-wide regression analysis was then done.[10] These results for economic involvement (Tables 7 and 8 in Appendix C) reveal that trade with the superpowers, especially the United States, is generally a function of a nation's economic well-being as a country's GDP

[9] These two variables are also manipulable in simulations (see Chapter 3). An increase in U.S. or Soviet GNP, for example, arbitrarily altered by the analyst may encourage trade between the superpower and the countries in a region.

[10] The regression results for these economic involvement equations (Appendix C) show a large number of cases. This is due to the additional years of data in the time-series.

is key to involvement in the international economic sector. GDP size is indicative of a nation's ability to absorb goods and services. Thus, GDP enters into the U.S. import equations (TIMUS) for each region. Clearly, a country's ability to absorb U.S. goods and services is enhanced or constrained by its GDP.

On the other hand, a nation's GDP is often indicative of the strength and diversity of its economy. Diversification and industrialization enable the production of more goods and services for export. Hence, a nation's GDP should partially explain growth, or fluctuation, in its exports to the United States. In addition, the size of a nation's import market is a factor in international economic involvement. As a result, a nation's population partially influences the size of its imports from the United States.

Because international economics often reflects the operation of certain international political forces, U.N. voting behavior was included to test whether a country's political behavior in that organization could influence its economic orientation. As Tables 7 and 8 reveal, this is the case in several instances.

Interestingly, the TIMUS and TEXUS equations for each region contain both the economic and political variables. VOT0US also enters into each regional equation. Indeed, the structure of each regional equation is remarkably similar. However, this is not so in equations for Soviet Union and China (TEXSU, TIMSU, TEXCH and TIMCH) where motivations for trade with these two superpowers are far less systematic. As demonstrated in Tables 7 and 8 of Appendix C, the lower multiple R^2s and a general mix of independent variables appear across regions for Soviet and Chinese trade.

The picture is less systematic for China. Only in the equations for Europe is consistent behavior exhibited. European interaction with

China appears to be purely economically based. China clearly requires basic and advanced manufactured and technological goods and services from Europe. Europe's larger, more elaborate economies are thus excellent trading partners for China.

China's relative isolation during the 1960's and its internal self-sufficiency explain the paucity of strong results from the remaining regions. However, the results presented in Appendix C are preliminary. The parameters presented may vary when the final model is assembled. Nonetheless, the regression results do accurately depict the international economic structures of the four regions. Consequently, forecasts generated by the final equations should provide realistic projections on international economic involvement with the three superpowers.[11]

INTERNATIONAL ALIGNMENT SECTOR

International alignment is a key international relations concept that is relevant to national security policy planning. Previous research by CACI (1974) on Europe focused on political alignment with the Soviet Union and the United States. Because international alignment is far more complex in the less-developed countries, additional measures were included to assess this behavior in the Africa, Latin America, and Middle East models. The multidimensional character of international alignment in the less-developed regions necessitated adding international economic alignment and international arms alignment (CACI, 1975a, 1975b). International economic alignment was measured by the proportion of exports and imports going to and from the two superpowers. International arms alignment was captured by important linkages between countries composed of aid and trade in military hardware. Less-developed countries

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[11] International economic alignment is based on the forecast values of a nation's activities with the three superpowers. International economic alignment is calculated in the forecasting model after total trade (TRDTOT) is calculated. The projections of TIMUS and TEXUS are summed and divided by a nation's total superpower trade.

are often dependent on a particular superpower for their arms. In Europe, this linkage is much more voluntary and is characterized by international arms trade rather than arms aid. A final, but less significant factor that contributes to alignment is economic aid. This concept is measured as the ratio between aid from one superpower and the total aid received by a particular country. Of course, relative economic aid has little current meaning in Europe.

International Economic and Arms Alignment

Table 3 shows the equations for international trade and arms alignment for all regions. Earlier research on international political alignment (CACI, 1974, 1975a, 1975b) served as the model for developing the measures of international economic alignment. Studies often identify direction and intensity as two key dimensions, of alignment. In the earlier research, CACI translated these two notions into quantitative measures based on relationships of each country with the United States and the Soviet Union. Each country was located relative to the two superpowers. For the European nations, political alignment alone was analyzed and the countries were located relative to the United States and the Soviet Union by their U.N. voting agreements with each.

This same measurement model was employed in the less-developed regional analyses. As a result, each nation in the three less-developed regions was identified as more involved with either the United States or the Soviet Union (direction of alignment) and more or less involved with both superpowers (intensity of alignment). To capture the important international economic linkages that exist between the superpowers and the less-developed regions, and to try to capture the influence of military dependence, a similar approach was taken using relative trade and relative arms transfers. Thus, values for each nation could be located on trade, aid, and arms variables depending on the direction and intensity of involvement with the Soviet Union. In Table 3, the dependent

TABLE 3

Theoretical Equations: International Trade and Arms Alignment for All Regions

Equation Number	Forecast Variables	Predictor Variables[c]														
		TRADUS	TRADSU	TRADCH	TRDTOT	UST[b]	SUT[b]	CHT[b]	USA	USM	SUA	SUM	CHA	CHM	ISUM	MSUM
20	TRADE[a]	X	X	X	X											
21	TRADUS	X			X											
22	TRADSU		X		X											
23	TRADCH			X	X											
24	IST[a]					X	X	X								
25	MSUM[a]									X		X		X		
26	ARMUS[b]					X				X					X	X
27	ARMSU[b]						X					X			X	X
28	ARMCH[b]							X						X	X	X
29	RELATD[a]								X	X	X	X	X	X		

[a] This is an identity equation. The dependent variables are arithmetic combinations of the predictor variables.

[b] The data used for the European region are arms sales. For the definition of this variable see ACDA (1976).

[c] See Appendix B for variable definitions, years, and sources.

variables reflect the direction and intensity of involvement as TRADR refers to the intensity of trade alignment with the superpowers and TRADθUS reveals the extent to which a nation is economically oriented toward the United States.

These dependent variables are calculated in the forecast of a particular region. First a country's dollar value on future exports and imports to and from each superpower is forecast using the equations discussed in the last section. These are summed, giving total trade with each superpower. The TRADθ values are then calculated as the ratio of each superpowers trade to total superpower trade. The TRADR values are the ratio of a nation's trade with all superpowers to its total trade (exports and imports) that is forecasted by the economic sector of the forecasting model.

International economic alignment reacts both to growth in the economy of a particular country and growth in the economies of the superpowers. In a similar fashion, trends in military dependency are shown to follow patterns of economic growth. However, in the current model arms alignment is not forecasted. Rather, it serves as an independent, manipulable variable whose influence on other sectors of the forecasting model can be altered by the analyst. Finally, because these international economic and arms alignment variables are not directly forecasted, empirical analyses were unnecessary.

International Political Alignment

International political alignment for Europe and the less-developed countries has been discussed at length elsewhere (CACI, 1974, 1975, 1975b). Those reports presented considerable detail to support the equations specified for generating forecasting parameters. To equalize the models, the European voting equations were reexamined in detail. Operational measures were identified to upgrade the European model and the European alignment sector was completely redone. Table 4 shows the respecified equations for U.N. voting alignment in Europe.

TABLE 4

Theoretical Equations: U.N. Voting Alignment

Europe

Equation Number	Forecast Variables	Predictor Variables[c]													
		GOVT	LVOTR[b]	TRADR	LTRADR	GDPOP	ΔGDPOP	LCONF	ΣTOTA	TRADθUS	TRADθSU	TRADθCH	VOTθUS	VOTθSU	VOTθCH
30	VOTR	X	X	X		X		X	X						
30a	VOTR	X	X			X		X	X						
30b	VOTR	X	X				X	X	X						
31	VOTθUS	X				X			X	X	X	X			
32	VOTθSU	X				X			X	X	X	X			
33	VOTθCH	X				X			X	X	X	X			
34	ALINSUS[a]									X			X		
35	ALINSSU[a]										X			X	
36	ALINSCH[a]											X			X

Middle East, Latin America, Africa

Equation Number	Forecast Variables	Predictor Variables[c]																	
		GOVT	LRELAID[b]	ARMθUS	ARMθSU	ARMθCH	LVOTR	TRADR	LTRADR	GDPOP	ΔGDPOP	LCONF	LTHL	IMILA	TRADθUS	TRADθSU	TRADθCH	VOTθUS	VOTθSU	VOTθCH
30	VOTR	X					X	X				X	X	X	X	X	X			
30a	VOTR	X							X		X	X	X	X	X	X	X			
30b	VOTR	X					X		X	X		X	X	X	X	X	X			
30c	VOTR	X					X		X		X	X	X	X	X	X	X			
31	VOTθUS	X	X	X	X	X									X	X	X			
32	VOTθSU	X	X	X	X	X									X	X	X			
33	VOTθCH	X	X	X	X	X									X	X	X			
34	ALINSUS[a]														X	X	X	X		
35	ALINSSU[a]															X			X	
36	ALINSCH[a]																X			X

[a] This is an identity equation. The dependent variables are arithmetic combinations of the predictor variables (for example, GDP = CONS + INV + TEX - TIM).

[b] In all tables, variables preceded by an "L" indicate a time lag of 1 year, so that $LCONS = CONS_{t-1}$ (that is, consumption for the previous year). A summation sign (Σ) indicates the addition of 5 years of nation data for the variable. A delta (Δ) indicates change over two time periods, for example $\Delta GDP = GDP_t - GDP_{t-1}$.

[c] See Appendix B for variable definitions, years, and sources.

The forecast equations for voting alignment for the three less-developed regions were also carefully scrutinized. This effort produced a single, less-developed region equation for voting intensity and voting direction as the best approach to forecasting political alignment with the three superpowers. Finally, alignment instability (ALINS) had to be modified to accommodate China in the equation. Thus, alignment instability currently reflects the imbalance between political and economic alignment with each superpower. However, only by looking at alignment instability for each of the superpowers and comparing the extent of such imbalances can the analyst get a true feel for extent of disequilibrium in a nation's alignment with any particular superpower.

As in the international alignment sector, VOTR refers to the intensity of involvement with the three superpowers in U.N. voting. Thus, VOTR reflects the extent to which a nation participates in issues involving the superpowers in the United Nations. The VOTθ measures refer to the propensity of a nation to vote with (in the direction of) one superpower. The independent variables hypothesized to explain voting intensity and voting direction are also shown in Table 4. In Europe, involvement intensity results from a combination of international and domestic conditions. International forces are represented by trading involvement (TRADR, LTRADR), past voting patterns (LVOTR), military hardware acquisition over-time (ΣTOTA), and past conflict levels (LCONF). Government type (GOVT) and economic well-being (GDPOP) are domestic factors hypothesized to contribute to vote intensity. Although three separate equations are proposed for VOTR to capture subtleties in the relationship resulting from the differential impact of variables led and lagged over time, only the single best equation will go into the model.

The direction of alignment (VOTθ) with each of the superpowers is a function of national wealth (GDPOP), government type (GOVT), military hardware acquisition over time (ΣTOTA), and the extent to which a country trades with the three superpowers (TRADR). While the idea that voting

agreement with the United States is in part a function of trade with the Soviet Union, voting agreement with the United States might be positively influenced by trade with the United States but negatively influenced by trade with the Soviet Union. This means that the more a country trades with the United States, the more likely it is to vote with the United States in the United Nations. Similarly, the less it trades with the Soviet Union, the more likely it is to vote with the United States. This argument applies to all VOTθ equations.

In the less-developed regions, past international behavior (aid, arms transfers, trade intensity, trade direction, and military aid) is postulated to predict to voting intensity and voting alignment. Also included in these forecasting equations are domestic conditions such as relative wealth (GDPOP), government type (GOVT), and domestic instability (LTML). The equations capture the momentum in international trade among nations and the varying impact of relative wealth and domestic unrest that typify so many of the less-developed countries. Finally, the predictor variables that measure military arms transfers and aid capture the extremely important tendency of less-developed nations to be dependent on the superpowers for their military hardware.

The empirical results from the earlier research (CACI, 1975b), revealed that these posited variables are significant predictors in the less-developed regions. However, the addition of China to the influence set required that the VOTR and VOTθ equations be respecified and reestimated. As already indicated, alignment instability had to be reoperationalized to add China to the model and equalize all four regions.

Research Findings

Parameters for international political alignment were estimated with OLS regression analysis. Political alignment was analyzed two ways. First, a country's total involvement in U.N. issues concerning the superpowers

was analyzed for each region using cross-sectional data. Second, voting with each of the three superpowers was analyzed by region. The first analysis identifies parameters explaining the involvement of the nations in a region in superpower issues. The second identifies parameters that explain involvement of the nations in a region with one particular superpower. These analyses (Appendix C, Tables 9 and 10) show that both international and domestic factors explain U.N. voting behavior, reflecting the extent to which nations are economically, diplomatically, militarily, and politically linked to the superpowers. In addition, the government type variables (see Chapter 2), domestic economic conditions, and political stability are important.

Total Political Alignment (VOTR). VOTR measures the extent to which nations are involved with the superpowers in the United Nations, revealing how strongly national and superpower interests coincide in that forum. Table 9 in Appendix C presents the VOTR analyses for the four regions, showing that international economic forces are by far the most influential. While trade influences the behavior of the less-developed regions, European voting is more strongly influenced by previous U.N. voting. Since European nations were more a part of the rigid U.S.-Soviet alignments of the 1950's and 1960's, this result is plausible.

Government type enters all but one equation on international behavior. Only in the Middle East does GOVT not appear. In Europe, Western-style democracies (GOVT1) and superpower issue involvement are negatively related, in part because VOTR70 is weighted in favor of the Soviet Union and China since both are included in its calculation. Not all Western nations are type 1 governments. Hence, their influence in the equation is diluted. If GOVT2, Eastern European-style Communist Governments, had been used in the analysis this parameter most certainly would have been positive for the same reason.

Government type also plays a role in the less-developed regions. The tendency for African nations to be aligned with the Soviet Union and

China is negatively related to African voting behavior. In Latin America, very traditional nations (GOVT5) account for a small portion of voting involvements. In, addition, the Latin American tendency to criticize the developed economies and gain support from China and the Soviet Union also accounts for these results.

Political Alignment with Each Superpower (VOTθ). Similar results are obtained when a nation's voting patterns with either of the three superpowers are analyzed (Appendix C, Table 10). In Europe, voting with the United States is clearly a function of political type, western democracy, degree of military dependency, and superpower trade. Nations that are politically similar to China and the Soviet Union or that trade with those countries in military and non-military goods, vote against the United States.

U.S. arms trade strongly influences U.N. voting in the Middle East, as does relative economic aid received and trade with each superpower. As the equations in Table 10 of Appendix C clearly show, trading and U.N. voting in the Middle East are polarized. On the other hand, the results for Latin America are somewhat confusing, in part because the data on social systems often fail to conform to the linearity assumed by regression analysis. Although some parameters in Table 10 are large (and will have to be modified) the signs are interpretable. The presence of Cuba, an Eastern European Communist-Style Government (GOVT2), clearly produces anti-U.S. voting in the United Nations.

Latin American voting agreement with the Soviet Union also reflects Cuba's presence and reinforces the importance of international trade. However, voting agreement and trade with China are inversely related, suggesting that China's slow emergence into international affairs has gained little momentum that could be construed as a "normal" mix of international politics and economics. Instead, it appears that Chinese politics in the United Nations and economics in trade remain somewhat independent of each other.

In Africa, U.S. arms influence those who agree with the United States in the United Nations, while trade and aid influence Soviet supporters. Leftist regimes with economic linkages to China produce votes for Peking. These three equations clearly portray emerging Africa with a multipolar orientations to the United States (Republic of South Africa, Zaire, Kenya), the Soviet Union, (Somalia, Sudan, People's Republic of Congo), Europe (Niger, Nigeria, and many small West African states), and China (Tanzania and the Malagasy Republic). Thus, both international and domestic forces are at work in Africa influencing international political behavior.

THE DEFENSE SECTOR

Theoretical Considerations

The JCS/J-5 forecasting models for Africa, Latin America, and the Middle East define military power as resources and skills available for use in both international and domestic conflict (CACI, 1975a, 1975b).[12] As a result, defense spending (DEFX) and military manpower (MILMAN) are used in the less-developed region model to represent the defense sector. Although the meaning of the forecast output variables (DEFX and MILMAN) are conceptually similar across regions, variables for each regional equation differ (as shown in Table 5). Thus, equalizing the defense sector presented a most difficult problem.

In the European model, defense spending as a percent of GNP was forecast by changes in previous defense spending per GNP, the size of the economy, major power alignment, and the history of international and domestic conflict (CACI, 1974: 46-66). This conceptualization was appropriate for

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[12] In the less-developed regions the use of military forces to maintain domestic stability is well known. The application of military pressure to domestic unrest in the European region, although less common, does occur. Military involvement in domestic disturbances in Portugal, Spain, Greece, Turkey, and Italy are examples of this point.

TABLE 5

Theoretical Equations: Defense Sector

Europe

Equation Number	Forecast Variables	Predictor Variables[c]												
		UST	SUT	ΔGDP	LCONP[b]	LDEFX	DEFX	ΔPOP	ΔDEFX	POP	MILMAN	LMILMAN	GDP	RRIVDEFX
8	TOTA[a]	X	X											
9	ΔDEFX				X									
9a	DEFX				X									X
9b	ΔDEFX[a]					X	X						X	X
10	ΔMILMAN				X			X	X					
10a	MILMAN				X	X				X				X
10b	MILMAN[a]										X	X		

The Middle East

Equation Number	Forecast Variables	Predictor Variables[c]												
		USM	SUM	RIVDEFX	GDPOP	LMILA	DEFGDP	ΔCONP[b]	ΔDEFX	LDEFX	ΔPOP	LMILMAN	ΔDEFX	MILMAN
8	MILA[a]	X	X											
9a	DEFX			X	X	X	X	X						
9b	ΔDEFX[a]								X	X				
10a	MILMAN													
10b	MILMAN										X	X		
10c	ΔMILMAN[a]					X	X				X	X	X	
												X		X

[a] This is an identity equation. The dependent variables are arithmetic combinations of the predictor variables.

[b] In all tables, variables preceded by an "L" indicate a time lag of 1 year, so that LCONS = $CONS_{t-1}$ (that is, consumption for the previous year). A summation sign (Σ) indicates the addition of 5 years of nation data for the variable. A delta (Δ) indicates change over two time periods, for example $\Delta GDP = GDP_t - GDP_{t-1}$.

[c] See Appendix B for variable definitions, years, and sources.

TABLE 5 (cont'd)

Latin America

Equation Number	Forecast Variables	Predictor Variables[c]														
		USN	SUN	GDP	RIVDEFX	MILMAN	ECSUP	TML	LDEFGDP[b]	LCONF	GDPOP	LTML	DMIL	LDEFX	LDEFX	LMILMAN	LDEFX
5	MILA[1]	X	X														
[illegible]	[illegible]			X	X	X	X	X	X								
9	DEFX				X				X	X	X	X	X				
9b	LDEFX[d]														X		X
[illegible]	[illegible]							X		X			X	X			
[illegible]	[illegible]									X	X	X	X		X		
[illegible]	[illegible][d]					X										X	

Africa

Equation Number	Forecast Variables	Predictor Variables[c]														
		USN	SUN	LCONF[b]	RIVDEFX	LDEFGDP	LGDPOP	LTML	LMILA	LDEFGDP	GDPOP	DEFX	LDEFX	LMILMAN	MILMAN	
8	MILA[1]	X	X													
9	LDEFX			X	X	X	X	X	X							
[illegible]	[illegible]			X	X			X	X	X	X					
[illegible]	[illegible][d]											X	X			
[illegible]	[illegible]			X	X			X	X		X	X				
[illegible]	[illegible]													X	X	

[1] [illegible] variable definitions. The following variables are arithmetic combinations of the predictor variables (for example, GDP = CONS + INV + TEX -

[b] In all tables, variables preceded by an "L" indicate a time lag of 1 year, so that LCONS = CONS$_{t-1}$ (that is, consumption for the previous year). A [illegible] (Δ) indicates the addition of 5 years of nation data for the variable. A delta (Δ)[b] indicates change over two time periods, for example LGDP = GDP$_t$ - GDP$_{t-1}$.

[c] See Appendix B for variable definitions, years, and sources.

Europe, where most nations are military alliance members and have industrial economies with relatively high defense spending. Thus, defense spending is largely determined by factors operating within the individual nations. In contrast, defense spending in the less-developed region models was hypothesized to respond to extraregional superpower influence and domestic, political and economic factors. Therefore, the generalized forecast equation for the developing region models predicted that changes in defense spending would result from changes in wealth, arms race involvement, conflict and arms transfers, or military assistance from the superpowers.[13] At the same time, the existing J-5 models all predict military manpower from past trends and introduce conflict, turmoil, and arms race variables as potential causes of deviation (CACI, 1975a: 56).

The basic structure of the existing models has not been revised in this research. As Table 5 shows, equations 9-9b describe defense spending, while equations 10-10c provide alternative means for forecasting military manpower. The Europe model has the simplest structures. Defense spending is hypothesized to respond to national wealth, previous conflict, and defense spending by rival alliances or individual country rivals (such as Greece-Turkey). Individual country rivals (ERIVDEFX) replace the two separate alliance-related variables of the earlier Europe model and include rival country and potential for arms race of the less-developed region rival defense expenditure (RIVDEFX) variable.[14]

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[13] Because of the emphasis on change in the values of the forecast variables, the preferred equations predict change (Δ) values. Alternative equations, in which change values are computed from annual forecast values, are given for possible substitution in those cases where change parameters cannot successfully or satisfactorily be derived.

[14] See CACI (1975a: 55) for a detailed review of the theoretical and empirical background to this variable. Rivalries were operationalized as localized conflicts and arms races in the less-developed region models. However, the existence of the North Atlantic Treaty Organization (NATO) and Warsaw Treaty Organization (WTO) military alliances in Europe make it more realistic to consider relations with the rival alliance as the major

The equations for the Middle East and Africa are the same as those in the existing J-5 models. For the Middle East, defense spending responds to wealth, military assistance from the superpowers, traditional defense share of the budget, possible involvement in arms races, and history of conflict. African defense spending responds to similar stimuli. Superpower involvement is represented by military assistance. History of conflict and potential for arms races movement are represented by lagged conflict in Africa, a 5-year history of conflict in the Middle East, and rival defense spending for both. Wealth is measured in both regions by per capita GDP, although the greater economic volatility of the African countries is reflected by using change in GDP per capita (ΔGDPOP) in the Africa model. The defense share of the national budget is represented in both regions by defense spending as a percent of GDP. Again, greater volatility is suggested for the African region in the use of the change value of the variable (ΔDEFGDP). Domestic conflict is absent in the Middle East equations but is introduced for Africa. Theoretical and empirical studies have suggested that domestic mass conflict (TML) requires governments to spend more on defense to control unrest. In addition, domestic conflict frequently results in military coups that have at least short-term consequences of higher defense spending (CACI, 1975a, 1975b).

Two alternative equations are hypothesized for Latin America. Equation 9a uses the same variables and theoretical rationale as in Africa and

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stimulant to increased or decreased defense spending. At the same time, several countries, such as Greece and Turkey or East and West Germany, have local rivalries as well as alliance-based rivalries. Greece and Turkey are even rivals at the local level but are allies in the regional alliance. Therefore, ERIVDEFX is computed as the sum of opposite alliance defense spending (including superpower contributions) and individual rival defense spending. While rivalries are generally hypothesized to stimulate defense spending, alliance membership may cause a country to spend less (Olsen and Zeckhauser, 1966; Pryor, 1968). Therefore, ERIVDEFX may have a negative parameter in the DEFX equation for Europe, while RIVDEFX may have a positive value in the other regions.

the Middle East. Equation 9b, introduced to reflect the considerable differences between Latin America and the other less-developed regions in superpower involvement and intraregional conflict, hypothesizes that traditional budget shares, resource availability (measured by size of GDP), and military size are the prime determinants of Latin American defense spending. These basic determinants are modified by domestic events such as level of turmoil and number of coups, and by international political considerations such as rival defense spending. International conflict is omitted, as is military assistance, since both were largely terminated in the region by 1970.

A nation's military manpower is hypothesized to remain fairly stable unless unusual circumstances, such as international conflict or turmoil, occur (CACI, 1975a: 56). As a result, a simpler equation for Europe has been developed. The equations for Africa, Latin America, and the Middle East remain substantially similar to the existing JCS models. Equations 10-10c in Table 5 present various equation structures. European military manpower is hypothesized to result primarily from population size and size of the defense budget. These two variables reflect the relatively stable military situation in Europe. A conflict term is introduced to permit manpower increases in response to international tensions. Equations for the less-developed regions predict military manpower from size of the defense budget and overall wealth, superpower military assistance, and conflict. Regional differences are reflected by introducing turmoil in Latin America and Africa, rival defense expenditures in Africa, and previous manpower levels in the Middle East.

Research Findings

Analyses of the defense sector for the four regions are presented in Appendix C, Table 11. All these analyses are cross-sectional, by region. Thus, each region is modeled distinctly, capturing the domestic and international forces behind defense spending and military manpower that are specific to that area.

GDP is the best domestic predictor to defense spending in Europe, although it is complemented by the degree that those countries conflict with one another. Of course, conflict in Europe is generally non-violent (as noted in the International Conflict section). Nevertheless, these research findings support the hypothesis that, regardless of severity, conflict provides one impetus or defense spending.

Rival defense spending, another predictor, reflects the extent to which NATO and the WTO influence defense spending in Europe. The negative parameter supports arguments by students of international alliances that alliance members spend less individually on defense because they obtain more collective benefits from the alliance (Olson and Zeckhauser, 1968). Domestic and international forces (including alliance behavior) jointly influence the size of military forces (Appendix C, Table 11).

U.S. and Soviet behavior significantly influence defense expenditures in the Middle East. The positive relationship between military aid over time (ΣMILA) and conflict indicates the central role of superpower influences in the region. Defense spending is also a function of spending by rivals, suggesting a residual hostility and mutual fear in the region even without superpower involvement. Finally, military manpower in the Middle East results from both domestic and international forces. Most important, however, the level of military manpower is highly dependent on previous force levels.[15]

Defense spending in Latin American and U.S. support for Latin American defense establishments is represented in the DEFX equation, where the size of the military is a function of previous defense spending. Wealthier countries in the region tend to divert funds to improve force quality rather than channel monies into larger forces as reflected in the negative GDPOP parameter.

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[15] The dominance of lagged military manpower is so disproportional that the term was deliberately forced into the equation last to dampen its influence.

Past conflict overwhelmingly impacts on defense spending in Africa. Clearly, conflict and defense spending reinforce one another in Africa in a classic feedback system. The equation also shows that wealthier nations maintain larger military establishments. Military manpower in Africa seems to behave similarly to Latin America as growth in defense spending (ΔDEFX70) negatively impacts on expanding militaries. Thus, when nations in Africa increase defense spending, force quality rather than force size is improved. Nevertheless, the traditional character of the African militaries remains mostly a function of previous manpower levels that are maintained for national security.

THE DOMESTIC CONFLICT SECTOR

Theoretical Considerations

The domestic conflict sector in both the European and less-developed region models was based on widely accepted theoretical and empirical work by Gurr (1970) and others (CACI, 1974: 141-214; CACI, 1975a: 65-72). The European model operationalized domestic conflict by summing anti-government demonstrations and riots (TURMOIL) and armed attacks against public and quasi-public institutions (REVOLT). In the Africa, Latin America, and Middle East models, civil conflict (TURMOIL) was given a somewhat more complex definition, with societal instability determined by maldistribution of social and economic opportunities and by inconsistencies in economic performances and prospects. Governmental instability was represented directly by coups d'etat (COUP). Domestic conflict measured in these models differs substantially from one region to another. After reviewing the concept and the empirical work for the different regions, a decision was made to retain these definitional and operational distributions.

Domestic conflict for Europe had to be reoperationalized so that variables would be consistent across regions. The original European model

predicted TURMOIL as a function of population, previous strife, alignment, military power base, negative government sanctions, and trade alignment. The present model, presented in Table 6, substituted lagged turmoil for strife in Equation 37. Military power base is represented by defense expenditures as a percentage of GDP (DEFGDP), while multiple directions of trade are reflected in the three trade indicators with the United States, the Soviet Union, and China. One new variable is added to the Europe equations. Strain, introduced in the less-developed region models, is operationalized for Europe as the difference between country per capita GDP and the regional average GDP (RELDEP). RELDEP reflects differences between nations rather than differences within societies suggested by strain. Nevertheless, it suggests the same potential for dissatisfaction that can emerge when the demonstration effect of substantial gaps in achievement of social benefits are perceived. Equation 38, forecasting REVOLT, is retained from the earlier European model. An alternative equation (38a), differing only in the use of summed domestic incidents for 5 years rather than yearly values, is also considered because of the relative paucity of armed attacks against government institutions in Europe.

Three alternative equations for forecasting TURMOIL are considered in African, Latin American, and Middle Eastern models. These are introduced because different empirical results were obtained in earlier efforts to forecast turmoil for the different regions. Equations 37-37b include time-lagged TURMOIL, history of government instability (COUPS), and military assistance (MILA). Social benefits, neglected because of defense spending (the "guns versus butter" trade-off) and relative efforts to contain conflict, are captured in the DEFGDP variable. Societal disequilibria, as already mentioned, are captured in the STRAIN variable.

Equation 38, for COUPS, is the less-developed region counterpart to the REVOLT equation for Europe. Coups occur very irregularly in all regions

and, despite their apparent patterns, are rarely predictable. Hence, they are very difficult to forecast except on a gross aggregate basis. Previous empirical research, reviewed to support development of the less-developed region models, and a reexamination of the phenomonon itself suggested that generalized equations for Africa, Latin America, and the Middle East together would be most adequate for forecasting coups.

Research Findings

Analysis of the data for Europe indicate that turmoil is best predicted by turmoil in previous years, degree of trade alignment with the United States, and current defense expenditures as percent of the GDP. RELDEP and degree of trade alignment with the Soviet Union, hypothesized to contribute to explaining turmoil, do not enter significantly into the equations (Appendix C, Table 12). Together the three predictors explain the percent of the variance in European domestic conflict. For the most part, these results are consistent with current theories and research findings. History of domestic conflict is a very probable precedent for cu ent unrest as countries experiencing such conflict are likely to spend a greater portion of their resources on military and police to control unrest.

Anti-government conflict in Europe is best predicted by the variable in equation 38a that reflect the historical experience of societal and anti-government unrest and of international conflict involvement. Equation 37b emerged as the best predictor set for domestic conflict in Africa, Latin America and the Middle East. As in the European equation both prior years conflict and current defense share of GDP emerge as important predictors. In addition, a history of coups, events frequently associated with widescale domestic protest, is a predictor of conflict in the less developed regions. The importance of a history of military assistance in domestic conflicts is not clear, although

most military assistance has gone to countries experiencing high levels of unrest. Therefore although the causal direction of the relationship is not clear cut, association between the phenomena is understandable.

In estimating coup propensity, data for the three regions were pooled to provide a larger data base for more accurate estimates. The hypothesized variable explained 57 percent of the observed variance in coups. Prior experience with domestic conflict best predicts current irregular government transfers. Coup history and military assistance history both enter the equations, thus exhibiting the same behavior as for domestic unrest. Per capita wealth (summed over the past three years) indicates the role that economic performance can play in undermining or increasing government stability. When economic performance is satisfactory, populations are less likely to experience dissatisfaction with the government and conditions for coups are less likely to prevail. This relationship holds for coups where ΣGDPOP is negatively related to coups. In other words, the less per capita income changes, the greater the coup propensity.

THE INTERNATIONAL CONFLICT SECTOR

Theoretical Considerations

International conflict played an important role in each of CACI's previous forecasting efforts (CACI, 1973, 1974, 1975a, 1975b). Although international conflict is an extremely volatile variable, it can be projected over time as a function of selected region-specific forces (Table 7). In Europe, international conflict is a function of both domestic and international variables that reflect previous foreign and domestic conflict, domestic and international economic behavior, and military power. While the predictors of international conflict vary greatly across the less-developed regions, current conflict was accurately forecast by previous international conflict. Once lagged international conflict (LCONF) entered as a forecast variable, region specific

TABLE 7

Theoretical Equations: International Conflict Sector by Region

Equation Number	Region	Forecast Variable	Predictor Variables[c]											
			TRADUS	TRADSU	LDEFGDP[b]	DEFGDP	LCONF	ERIVDEFX	ΔDEFGDP	SPCOOP	DEFX	$\widehat{DEFX}$	ΣCOOP	ΔDEFX
39	Europe	CONF	X	X			X	X	X					
40		TR[a]									X	X		
39	Middle East	CONF			X		X			X	X			
40		TR[a]									X	X		
39	Latin America	CONF				X	X							X
40		TR[a]									X	X		
39	Africa	CONF				X	X			X			X	
40		TR[a]									X	X		

[a] This is an identity equation. The dependent variables are arithmetic combinations of the predictor variables (for example, GDP = CONS + INV + TEX - TIM).

[b] In all tables, variables preceded by an "L" indicate a time lag of 1 year, so that LCONS = $CONS_{t-1}$ (that is, consumption for the previous year). A summation sign (Σ) indicates the addition of 5 years of nation data for the variable. A delta (Δ) indicates change over two time periods, for example $\Delta GDP = GDP_t - GDP_{t-1}$.

[c] See Appendix B for variable definitions, years, and sources.

forces then became significant. In most cases, the level of defense spending and international conflict are highly related. However, different forms of this variable are important for different regions.

Moreover, U.S. and Soviet cooperation with specific countries was linked to conflict in the Middle East and Africa (CACI, 1975b: 52-53, 71-72). Adding the People's Republic of China to the superpower influencers required that data on its cooperative behavior be obtained and entered into these equations. The resulting superpower cooperation variable (SPCOOP) assesses U.S., Soviet, and Chinese cooperation with each country.

A Tension Ratio is calculated for each of the four regions assessing the extent to which actual defense spending exceeds expected spending based on a nation's GDP (CACI, 1975a: 76-78). Although the Tension Ratio is designed to signal when nations will go to war, it appears to be more useful when examined in conjunction with the conflict forecasts. Because the predicted monadic conflict values represent a weighted combination of conflict events that measure pressure, coercion, and physical conflict, the forecasts cannot be disaggregated to differentiate one from the other. Thus, it is impossible to distinguish nations engaging in much verbal conflict from nations engaging in small amounts of physical conflict, given the same forecast. However, if both the Tension Ratio and the conflict forecasts are simultaneously scrutinized, the analyst can observe when actual defense spending exceeds expected defense spending and whether the nation's monadic conflict values are large. Should this occur, one can infer that the conflict forecast will probably involve physical violence because the defense excesses are being used to prepare for war.

Research Findings

Table 13 in Appendix C presents the results of the cross-sectional analyses performed for each region. The data used in the analyses were

aggregated as in previous studies of international conflict (CACI, 1974, 1975a, 1975b). The conflict events have been coded from The New York Times and assembled into the World Event Interaction Survey (WEIS).[16] These data represent frequency counts of conflictful events, ranging from verbal to violent (CACI, 1975a: 72-76). The data were aggregated as pressure, coercion, or physical conflict. Once aggregated, each category was weighted and used in the regression analysis (CACI, 1975a: 75).

European conflict levels are generally historically derived.[17] Conflicts are not necessarily violent but can be verbal. The results simply suggest that conflict has a certain momentum at whatever level it currently rests. No indication of escalation can be identified with such analyses.

Rival defense spending, based on either a single rival's spending, a rival alliance's spending, or both captures the complexity of two party and multiple party arms races. Clearly, the competitive NATO-WTO rivalry is reflected in this equation. Two party rivalries were not significant as anticipated in the less developed regions. Rather, the extent to which superpowers get involved with specific nations appears a more viable measure in Africa and the Middle East.

As expected, some form of defense spending coocurrs with international conflict. Only in Africa does it play a major role, however. The percentage of GDP devoted to defense is an indicator of the amount of

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16 In addition to relying on the WEIS file for conflict data, WEIS was used to generate a superpower cooperation variable that measures the frequency of yearly cooperative events directed toward a country by the United States, the Soviet Union, and China. This is identified as Superpower Cooperation (SPCOOP).

17 This statement rests purely on empirical results. Lagged conflict is such a powerful predictor of current conflict that CACI analysts were forced to lessen its impact in Africa by slowing the point at which it entered into the equation.

resources that a nation can divert from other needs. When DEFGDP is large in an African nation, conflict is either imminent or ongoing. African Government's cannot presently afford large and expensive militaries. Thus, increasing DEFGDP is a good indicator of spending conflict.

SUMMARY

This chapter reviewed the structure of the long-range environmental forecasting model on a sector-by-sector basis for each of the four regions. Both the hypothesized equations and the empirically generated parameters have been discussed.

While these results provide major portions to the forecasting model, two other components -- introducing China to the superpower influence set and elaborating regime change in the model -- have not been discussed at any length. Hence, Chapter 2 describes how these areas of the model have been enriched.

CHAPTER 2. ENRICHING THE EXISTING LONG-RANGE FORECASTING MODELS

As long-range forecasting has evolved and users of long-range forecasts have become accustomed to employing computer-based aids to decision-making, modeling efforts have become more responsive to user needs. Defense analysts are now asking questions about the international security environment that require new, custom-tailored decision aids to provide meaningful answers.

In the current research, two substantive issues demanding such technologies are tackled simultaneously. The first involves adding the People's Republic of China (PRC) as a superpower so that defense analysts can manipulate and evaluate the impact of its behavior.[1] The second involves refining the modeling of regime change to enable analysts to simulate the impact of government change. Although these improvements make the new forecasting models more complex, they also enhance the realism and credibility of the forecasts. In both of these areas, user-initiated changes before or during a forecasting computer run permit new assumptions about either to be evaluated.

ADDING CHINA TO THE SUPERPOWER INFLUENCE SET

Adding the People's Republic of China to the superpower influence set to enrich the current forecasting models required four major research activities:

1. Review China's past international activity as described in recent literature and statistical records.
2. Identify the relevant dimensions of Chinese interactions with the world and isolate existing forecasting equations

[1] In the current generation of the Joint Chiefs of Staff (JCS)/J-5 models, only U.S. and Soviet behaviors are manipulable.

in which to include China as an active superpower. These include international alignment, international trade, and international conflict.

3. Evaluate empirically specific equations and ascertain the extent of Chinese impact on international and domestic conditions by identifying sources and data on Chinese behavior.

4. Restructuring the forecasting model to capture the impact of the People's Republic of China on all appropriate countries.

China's International Relations

Communist China's isolationist foreign policy since 1949 has been well documented. Only its aggression in Korea during the early 1950's runs counter to a general inward-looking orientation. However, during the 1960's the People's Republic of China began to make economic and diplomatic initiatives throughout the rest of the world and is currently seeking to expand the economic, political, cultural, and military linkages that are necessary to influence the international system (see Pye, 1972; Larkin, 1971; Mueller, 1975; Clubb, 1971, Gurtov, 1975; Lawrence, 1975).

Because of Chinese reticence to become extensively involved in international relations until recently, there is little systematic knowledge of, and evidence for, the major dimensions of Chinese international relations. Moreover, the lack of data available on Chinese international behavior has discouraged quantitative analyses to identify these dimensions and ascertain their stability and impact. Hence, most research on China's international behavior is discursive and descriptive. Few studies have even attempted to collect systematic data to perform rigorous analysis.[2]

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[2] One attempt (Rhee, 1971) is a study of China's foreign behavior in which quantitative data were collected from original Chinese, Korean, and Japanese sources and analyzed using contemporary statistical methods. The dimensions of China's behavior were identified as trade, formal diplomacy, nongovernmental, international organization memberships, negative communication, informal diplomacy, economic aid, and official visits.

Thus, this research is as much a pioneering effort in its attempt to establish empirically the degree of China's influence on certain domestic and international conditions in developed and underdeveloped countries.

Given the relative paucity of data on Chinese international behavior, the CACI research team decided to structure analyses parallel to those currently included for the Soviet Union and the United States. Hence, China's economic and military aid, international trade, arms transfers, and diplomatic and U.N. voting behavior have been added to the model. These variables reflect the major political, economic, and diplomatic diversions of all nations' international activities. Most studies refer to one or several of these activities as a major focus on current Chinese foreign behavior. Thus, it is felt that quantitative measures of these activities can be effectively used to estimate (1) the extent of Chinese activity in these areas and (2) the impact of these activities on the nations with which China interacts.

Specifying Forecasting Equations

The specific equations to which Chinese influence would be added were selected from previous analyses of U.S. and Soviet behaviors. Tables 4 and 5 in Chapter 1 indicate the equations through which Chinese influence was tested. Chinese influence was hypothesized to affect international economic involvement, international trade and arms alignment, U.N. voting, and, indirectly, the international conflict and defense sectors. Because the four regional forecasting models are interactive, the influence of China on one sector will invariably produce reverberations throughout the remaining sectors of each regional model in the same way as U.S. and Soviet impacts are felt.

Identifying Sources and Data on Chinese Behavior

Perhaps the most difficult aspect of this research phase involved identifying reliable sources and recent quantitative data for generating forecasting

parameters. Data on China have always been suspect. However, as the People's Republic of China continues to open to the West, more data are becoming available. Studies have begun to appear that assess the quality, reliability, consistency, and usability of Chinese statistics (Chen, 1975). Nevertheless, major difficulties with Chinese statistics, derived from concept definition, the extent of coverage, and classification (Chen, 1975: 65), do exist. Other deficiencies with political origins (such as withholding information that reflects poor performance) are also present. Chen (1975: 68) concludes that "Chinese statistics in terms of their availability, reliability, and usability are fraught with problems and difficulties," but adds that "the gradual resumption of some statistical outflows from China since 1970 has opened new research possibilities."

Thus, indigenously recorded data cannot be cited as truly representative of conditions within China (population and wealth, for example) and between China and other countries. CACI's research team attempted to include only the most reliable figures of Chinese gross national product (GNP) and population in the parameter-generating equations. In addition, the team relied on the statistics of China's trading partners for dollar values of imports and exports to ensure greater accuracy. Chinese aid, trade, and military assistance are reported each year by the Department of State/Bureau of Intelligence and Research. These data reflect the politico-military aspects of China's international relations and are considered reliable. Perhaps the most accurate record of Chinese international behaviors is reflected in the U.N. voting statistics used to capture purely political international behavior. Together, these data provide a representative sample of the major dimensions of Chinese foreign behavior that is consistent with the dimensions identified for the United States and the Soviet Union.

Research Findings

As already noted, empirically assessing Chinese behavior during the late 1960's and early 1970's is particularly difficult given China's relatively limited involvement in world affairs. This poses particular difficulties for estimating the pattern of Chinese activities for each of the four world regions covered in the forecasting models. Since the Chinese have clearly used trade, aid, and other patterned interactions as means to gain friends in specific regions or to extend their influence in other areas, the empirical result is a very uneven distribution on these variables. A very small number of countries have relatively large values on trade, aid, and other international exchange measures, but most other countries have nearly negligible values on the same variables.

Both region-specific and pooled analyses (where all the countries are considered in one group) were conducted on the data for the People's Republic of China. In some cases, most notably for voting partners in the United Nations, the results were statistical artifacts produced by the peculiar distributions of the data on [illegible]. In other cases the pooled results (obtained when all countries are considered jointly) are reported as the most reasonable outcomes.

China's Trade Behavior. Equations 1 and 2 present attempts to account for variations in imports both to and from China by the 90 other countries in the 4 regions. Unstandardized regression coefficients developed through ordinary least squares (OLS) estimation are displayed. The corresponding t-statistic (a measure of the statistical significance of the individual regression coefficient) is placed below in parentheses. Each equation is also accompanied by the coefficient of determination (R^2), a measure of the capability of the predictor variables to account for variation in either imports or exports as the dependent variable, and

the F-statistic, an assessment of the statistical significance of the complete regression equation.[3]

(1) Imports from China = 2.07 + 0.28 Population of the Importing Countries
(1.01) (3.39)

+ 0.02 Percent U.N. Votes with China
(1.12)

R^2 = .12 F (2,91) = 6.24 p <.003

(2) Exports to China = 5.81 - 0.0095 Gross Domestic Product
(2.39)(-2.42)

+ 0.39 Population of the Exporting Country
(2.47)

+ 0.03 Percent U.N. Votes with China
(1.22)

R^2 = .10 F (3,71) = 2.75 p <.049

Imports from China vary with the population of the importing country and the importing country's political alignment with China in the United Nations. Countries with larger populations have a greater volume of imports from the People's Republic of China. Across all 90 countries a population increase of 1 million increases imports from China by $280,000. The second major predictor (percentage vote with China in the United Nations) is weakly but positively associated with imports from China. While not statistically significant, the term remains in the equation to permit more elaborate assessments of the relationship between trade and U.N. votes as more data become available or as analysts want to stimulate the impact of different patterns of U.N. voting and trade with China.

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[3] These statistics are discussed at length in numerous treatments of regression analysis. One particularly readable account is found in Hu (1973). As a rough rule of thumb, the t-statistic (the assessment statistic for each individual term) should be greater than or equal to 2.00. The F-statistic (the assessment statistic for the entire equation) should be significantly different from zero at least 95 out of 100 times (expressed as p <.05).

Exports to China are produced by each country's gross domestic product (GDP), population, and percentage of voting agreement with China in the United Nations. Wealthier countries export less to China, while countries that are more populous or that vote more frequently with China in the United Nations export more to it. Across all 90 countries, a $1 billion increase in the GDP leads to a decline of $9.5 million in exports to China. A 1 million population increase is associated with a $390,000 increase in China's exports to the country. Although statistically non-significant, the positive association between votes with China in the United Nations and exports is retained to enrich the model's simulation capability (see Chapter 3).

China's Voting Partners in the United Nations. Equation 3 depicts the patterns associated with the percentage of votes with China in the United Nations in 1971. Percentage agreement with China in the U.N. General Assembly is a function of the voting country's GDP, the percentage of its trade with the United States, the percentage of its trade with China, and its type of government.[4]

(3) Percentage U.N. Votes With China $= \underset{(10.22)}{34.98} + \underset{(4.25)}{0.02}\text{GDP}$

$\underset{(-2.77)}{-14.40}$ Western European Democracies

$\underset{(-2.21)}{-4.23}$ Percentage Trade With the United States

$\underset{(1.80)}{+8.55}$ Modernizing Authoritarian Regimes

$\underset{(1.42)}{+186.32}$ Percentage of Trade With China

$R^2 = .35 \quad F(5,80) = 8.602 \quad p < .001$

Once trade and national wealth are controlled, countries averaged approximately 35 percent voting agreement with China in the 1971 U.N. General

[4] These government type variables are discussed in the second half of this chapter.

Assembly (α = 34.98). This average value is considerably lower for Western European democracies (approximately 20.5 percent) and higher for modernizing authoritarian regimes (43.5 percent). Since few Western European countries are positively oriented toward Peking, these results are not surprising. How extensively the modernizing regimes vote with China is more noteworthy. Moreover, countries that trade more with the United States are less likely to vote with China. Countries that trade more with China also vote more heavily with it.

INTRODUCING A REGIME CHANGE SIMULATION CAPABILITY

In revising and equalizing the existing JCS/J-5 regional forecasting models, CACI sought to make it possible for defense analysts to explore the impact of international political and economic processes on regime stability and change. Conversely, the impact of regime type on international behavior can be explored. The first process is dealt with as an integral part of the forecasting model. The latter is initiated by the user when operating in the simulation mode of the computer model. To develop these additional capabilities, the CACI research team

- Reviewed the current regime typology, developed a new typology that includes European regime types, and adjusted the data to include these regime types.
- Reviewed the stochastic process for regime change that is currently used in the developing region models.
- Selected equations that should be affected by or should affect regime change and linked regime type and other national attributes and behaviors.
- Developed a user-interactive regime change simulation capability.

Review the Current Regime Typology

The current JCS/J-5 regional models for Africa, Latin America, and the Middle East utilize government type (GOVT) to predict several measures

of alignment direction and intensity. Since government type had not been included in the earlier European model, it was necessary to review and expand the concept to include the European countries.[5]

After reviewing the GOVT concept, it was decided that the earlier coding schemes were too limited and, therefore, unsatisfactory for the new model. Accordingly, an expanded five-category classification was developed.[6]

> West European-type democracies. Generally industrialized economies with historically stable political systems where government change occurs through institutionalized parliamentary means. Popular participation in the political system is permitted, exercised, and meaningful (Lipset, 1960; Almond and Verba, 1963).
>
> East European-type Communist regimes. Generally industrialized economies with stable Communist political systems in which transfer of authority occurs or would apparently occur through institutionalized Communist Party/Central Committee procedures. Mass participation is solicited through strong socio-economic incentives to be Party members. Decision-making authority lies in the Central Committee (Rush, 1975; Mesa-Lago, 1971; Gonzalez, 1974).
>
> Modernizing authoritarian regimes. Industrializing economies in which the political elite manifests strong desires

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[5] Two variables, representing alternative conceptualizations of government, were tested in the J-5 developing region models. The first, GOVTI, categorized government type as populist (generally permitting mass participation in government decision-making), elitist (not permitting popular participation in decision-making), and mixed (sometimes populist, sometimes elitist), with coups (another variable in the models) usually stimulating government change. The second government-type variable, GOVTII, categorized regimes as civilian, military, and military-dominated civilian according to definitions and codes provided by Banks (1970).

[6] The reader will recognize rough developmental progression in the regime type categories. This progression is based on the most recent theoretical discussions and empirical analyses in the comparative politics literature. It reflects the complex sets of attributes associated with different regime types. It moves from the least-developed, traditional, elitist authoritarian regimes to populist democracies, and from there either directly to a West European-type democracy or an East European Communist regime, or indirectly to these regimes through a modernizing authoritarian interlude.

for rapid mobilization of political and economic national power. Government authority is concentrated in a small group of decision-makers, although mass participation is frequently solicited to legitimize decisions. These regimes may have civilian governments, but tend more frequently to be military governments. Once in power, the regimes are fairly stable. However, the social and economic circumstances in which they occur represent a transitional stage in economic, social, and political development (Linz, 1970; Schmitter, 1972; O'Donnell, 1973; Huntington and Moore, 1970; Huntington, 1968; Hayes, 1975).

Populist democracies. Generally less-developed economies and political systems that have adopted a Western democratic-type decision structure. The decision-making practices associated with political structures have not yet been institutionalized or legitimized, however. Such regimes are characterized by volatile mass participation. Demonstrations and unscheduled government changes are frequent. (Lipset, 1960; Nun, 1969; Ianni, 1968; O'Donnell, 1973; Huntington, 1968; de Schweinitz, 1966).

Traditional, elitist authoritarian regimes. Generally the least economically developed regimes. The primarily rural population exercises little or no influence on decision-makers. Heads of state are either hereditary leaders or dictators representing a small minority or isolated vested interests. Authority is concentrated, and national political and economic mobilization is generally not a goal (Binder, 1962; Apter, 1965).

Review and Further Develop the Regime Change Module

The JCS/J-5 forecasting models for Africa, Latin America, and the Middle East use a stochastic-based routine to examine the impact of regime change. This is set into operation when coup propensity (see CACI, 1975a; CACI, 1975b: 50-52, 61-62, 70-71) achieves a probability of 0.75 or greater. A random number is then generated and applied to Markov transition matrices to determine the new government type for the next forecast period. As currently programmed, government type exerts its major impact on international political alignment. Because the influence of government change is short-lived, government type and alignment are constantly in flux.

It became apparent that the random selection of a new government type was somewhat unrealistic and that the 0.75 coup propensity value was too high and tended to cause severe alignment instability. At the same time, the degree of alignment shift is constrained by the current government regime type and does not permit simulation of the substantial shifts that have occurred recently in many developing countries. Finally, the impact of regime change, currently found only for international alignment, needed to be expanded to other sectors of the model.

As a result of these considerations, new procedures were developed to evaluate the impact of regime change. First, two criterion variables -- level of economic development and extent of domestic turmoil -- were used to identify countries with the potential for regime change. These criterion variables are consistent with the new developmental typology for government type and with the recent scholarly literature treating politico-economic development and government change (Huntington, 1968; O'Donnell, 1973; Brewer and Brunner, 1975). Countries attaining limited economic development and extensive domestic turmoil were candidates for regime change. Once identified, these countries are displayed to the user, together with the years in which the criterion conditions are met. After the countries are identified, the regime change analyses discussed in the next sections can be undertaken by the users.

Establish Linkages Between Regime Type and National Attributes

National attributes and international behaviors differ across regime types. The differences between East European and West European behaviors in commercial and arms trade or in voting behavior are clear cut and determined in part by differences in regime type. The behaviors of many of the countries of Africa, Latin America, and the Middle East are less easy to categorize or predict but do reveal patterns and regularities from one regime type to another. Alignment behavior, for instance, can shift from one regime-type to another. Conflict potential might increase as a result

of a regime change as defense spending and arms purchases escalate efforts by elitist regimes to improve international prestige or pursue international expansionist goals. Defense spending and levels of capital investment differ from one regime-type to another (Schmitter, 1971; Weaver, 1973). Finally, domestic instability responds to regime changes in different ways (Gurr, 1970; Gurr and Duvall, 1973).

To reflect the policy differences associated with different regime types and the impact of government change on policy behavior, CACI researchers developed new procedures using separate forecasting parameters for the equations predicting investment, consumption, export, imports, defense spending, military manpower, voting alignment, and domestic and international conflict.[7]

Introduce Regime Change Simulation Capability

Regime change forecasts are based on empirical analyses and expert evaluations of the range of attribute values associated with the five different regime types. When the correct combination of forces builds to a predetermined level during a forecasting computer run, a country becomes a candidate for government change. In the standard forecasting mode, the user receives a message that the country has crossed the political instability threshhold and is a candidate for regime change. In the simulation mode, the user has the option of altering the regime type before the forecasting run begins.[8] In both modes, a list of the countries that become candidates for regime change and the years in which they become candidates is printed.

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[7] The parameters were generated in separate regression runs in which government type rather than region was used to differentiate subsets of the data base. They are stored separately in the computer program and replace the original parameters whenever government change is simulated.

[8] When entering the simulation mode the analyst may explore the implications of a regime change by arbitrarily substituting a new regime code at any appropriate year. Doing so will cause parameters associated with the selected new government type to be substituted for the original equation

This revised simulation approach eliminates the automatic stochastic process of the earlier model and places greater emphasis on evaluating and selecting emergent regime types. It is more restrictive since, to become a candidate for foreign change, a country must pass a variety of criterion "tests." The instability that became evident in the earlier forecasting models should be largely eliminated. The new approach also focuses on a broader spectrum of regime type, each of which has an associated set of clear, empirical or hypothesized policy behaviors. Thus the results of the revised regime change manipulation should prove of greater interest and utility to Department of Defense analysts.

SUMMARY

This chapter reviewed progress made in introducing two new capabilities into the long-range environmental forecasting models. First, procedures used and results obtained in adding the People's Republic of China to the superpowers covered in the model were discussed. Second, the procedures followed and the coding and analytical system developed to evaluate the impact of regime change on the behavior of the forecasting model were presented.

With these adjustments to the models originally developed for JCS/J-5, defense analysts will be able to simulate the impact of different international behaviors by China in each of the four world regions covered in the current research project. While many of the empirical parameters obtained for the data on China are quite small (particularly where China has only played a marginal role in the region), the capability to simulate changed patterns in China's behavior is now present in the model.

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parameters. For example, if an analyst is familiar with certain countries from extensive use of the forecasting model, the onset of a regime change in the countries may be accelerated. CACI's user-interactive preprocessor permits analysts to preset government change before the forecasting run begins.

Additionally, defense analysts can now simulate the impact of a change in regime type in a manner that is more realistic than could be done with the previous JCS/J-5 long-range forecasting models. Under the current format, the analyst can decide (1) whether to introduce a regime change where the conditions for change have been met, (2) decide, based on substantive judgment and experience, what type of regime switch is likely for the particular country, before (3) the internal computer algorithms continue the simulation with parameters that have been estimated based on the historical patterns for specific types of countries. In short, an analytical process has been developed that permits the substantively skilled analyst to maintain greater control over the operations of this particular sector of the forecasting model.

CHAPTER 3. COMPUTER PROGRAM DEVELOPMENT

All generations of CACI's long-range forecasting models have relied on the computer for data-based analysis to guide analysts in structuring the models and designing and assembling the final equation systems into each forecasting model.

The current research requires two major computer programming efforts.

1. Develop a capability to permit direct user interaction and simulation of alternative futures through on-line alteration of data files and/or parameters.

2. Restructure the existing Joint Chiefs of Staff (JCS)/ J-5 long-range forecasting models for Europe, the Middle East, Latin America, and Africa to

   - Standardize the model structure for all four regions;
   - Add the People's Republic of China to the manipulable superpower influence set;
   - Add the capability for simulating the impact of regime change;
   - Introduce the capability to alter a nation's rival, thereby permitting more realistic projections of the impact of arms races.

This chapter reviews the orientation toward user interaction found in this program, outlines the changed capabilities of the forecasting program, and reviews the ways in which the structure of the forecasting program has been modified to meet the requirements of defense intelligence analysts.

PROGRAMMING FOR USER INTERACTION

The final product of CACI's research on the Middle East, Latin America, and Africa is a generalized computer model that forecasts national and

international output variables for each region. Although the computer model is based on a general structure that applies to all regions, variables for individual regions and individual countries -- especially in the economic sector -- are forecast.

This computer model also includes the capability to simulate the impact of the United States and the Soviet Union as superpowers. However, this simulation capability was rather basic. To run the forecasting model, the user must compile the program and input base data using cards on which the simulation changes were made. This procedure was handled through batch input, making forecasting and simulation a rather cumbersome process.

The current project eliminates this procedure, substituting a computer program that consists of a basic forecasting model and an interactive preprocessing program. In this way, defense analysts can access the forecasting model from remote terminals, introduce whatever changes in base data or parameters they wish to evaluate, and generate forecasts.

Preprocessor Programming Philosophy

The revised forecasting program permits on-line changes in country attribute data and parameters. These changes will be made in a "preprocessor" program based on the following principles.

- The program is self-prompting. The user responds to requests for information; there is no need to remember the order or content of the entries to be made.
- The program will provide additional information at any point during preprocessing in response to the word "HELP."
- Information for each change is entered hierarchically as shown in Table 1. Each input section, such as "dependent variable names," is ended or bypassed by entering either "NO," "NONE," or "END."
- For any question logically requiring a "YES-NO" answer, the preprocessing program responds to only "NO." All other entries are treated as "YES."

TABLE 1

Hierarchical Order of Entries
for Attribute and Parameter Changes

Attribute Changes	Parameter Changes
Country Codes	Dependent Variable Names
Country Attributes	Parameter Numbers (country codes, for country-specific parameters)

Attribute Changes

When implementing the preprocessor and long-range forecasting models on the computer, the base data from which all forecasts begin are stored in a permanent file along with forecasting parameters, superpower behaviors, and regime change parameters. Changes requested by the user are stored in a temporary file and executed during a run of the forecasting model, leaving the permanent file unaltered. Implementation of the changes is accomplished by

- Placing attributes subject to changes in a single COMMON block;
- Declaring a one-dimensional array, Q, equivalent to this COMMON block;
- Computing the location in Q of the attribute value to be changed and the corresponding Q-value reset to the new attribute value.

All items stored for an attribute change are shown in Table 2.

Parameter Changes

As in the earlier long-range forecasting model for the developing regions, there are three types of forecasting parameters: region-specific, country-specific, and superpower-specific parameters (CACI, 1975a: 1-12).

TABLE 2

Information Stored for Each Change

Attribute Changes	Parameter Changes
Year of change	Year of Change
Country	Country (for country-specific parameters only)
Attribute	Dependent variable
Q-index	Parameter number
Old and new data values	Parameter code
	Old and new values

Because the three perform different functions during forecasting, each type is identified. The type of parameter is determined by the number of the forecasting equation.

- The equations representing the economic sector of the model, use country-specific parameters.
- The equations representing the remaining sectors, are region-specific parameters.
- The equations representing the impact of the United States and the Soviet Union in the current generation of the model, use superpower-specific parameters. China is added to these equations wherever necessary.

Parameter changes are treated similarly to attribute changes in which original parameters are equivalent to a temporary array. Specific information for locating the new information supplied by the user is retained (Table 2).

UPGRADING AND RESTRUCTURING THE FORECASTING MODELS

Although the forecasting model developed for JCS/J-5 remains basically intact, several programming changes have been necessary. Four major ones are discussed here. First, equalizing the models has required retesting

some forecasting equations to improve the quality and sensitivity of the forecasts. The CACI research team respecified most of the European forecasting equations, making them equivalent to those generated for Africa, Latin America, and the Middle East (see CACI, 1975a: 5-8). Because of substantive differences among the four regions, some equivalences simply do not exist. Consequently, the European region requires specific programming to accommodate these uniquenesses.

Second, adding China to the superpower influence set dictated some changes. Chinese behaviors had to be included as independent variables in equation testing (see Chapter 1). All forecasting equations containing superpower influence variables had to be restructured to include China. Once superpower-specific parameters were developed for China's influence, the forecasting program had to be altered accordingly.

Third, the regime change module was substantially modified from the JCS/J-5 format. In the regional models for Africa, Latin America, and the Middle East, regime change was assessed by activating a stochastic processor for countries identified as candidates for regime change. Altering regime change to a user-initiated simulation necessitated virtually complete reprogramming. This change requires storage of a set of new parameters specific to the five regime types (Chapter 2), commands to access the new parameters, and internal substitution commands for replacing existing parameters with new ones when government change is simulated.

Fourth, CACI introduced the capability to alter each country's international rival to determine the effect of increased or decreased rival defense spending on selected domestic and international behaviors. Although changing a nation's rival is a data change (described above), some additional programming was required to substitute the rival and the rival's defense spending for the appropriate year when a nation's adversary is altered.

SUMMARY

This chapter described the development of the "preprocessor" program to make the existing JCS/J-5 developing regions forecasting models interactive. Specific structural changes in the forecasting program required to equalize the forecasting models, enrich the complexity of the European model, add China to the superpower influence set, introduce the capability to simulate regime change, and add the capability to change a nation's international rival were discussed. Figure 1 summarizes the flow of the preprocessor and the forecasting programs as currently designed.

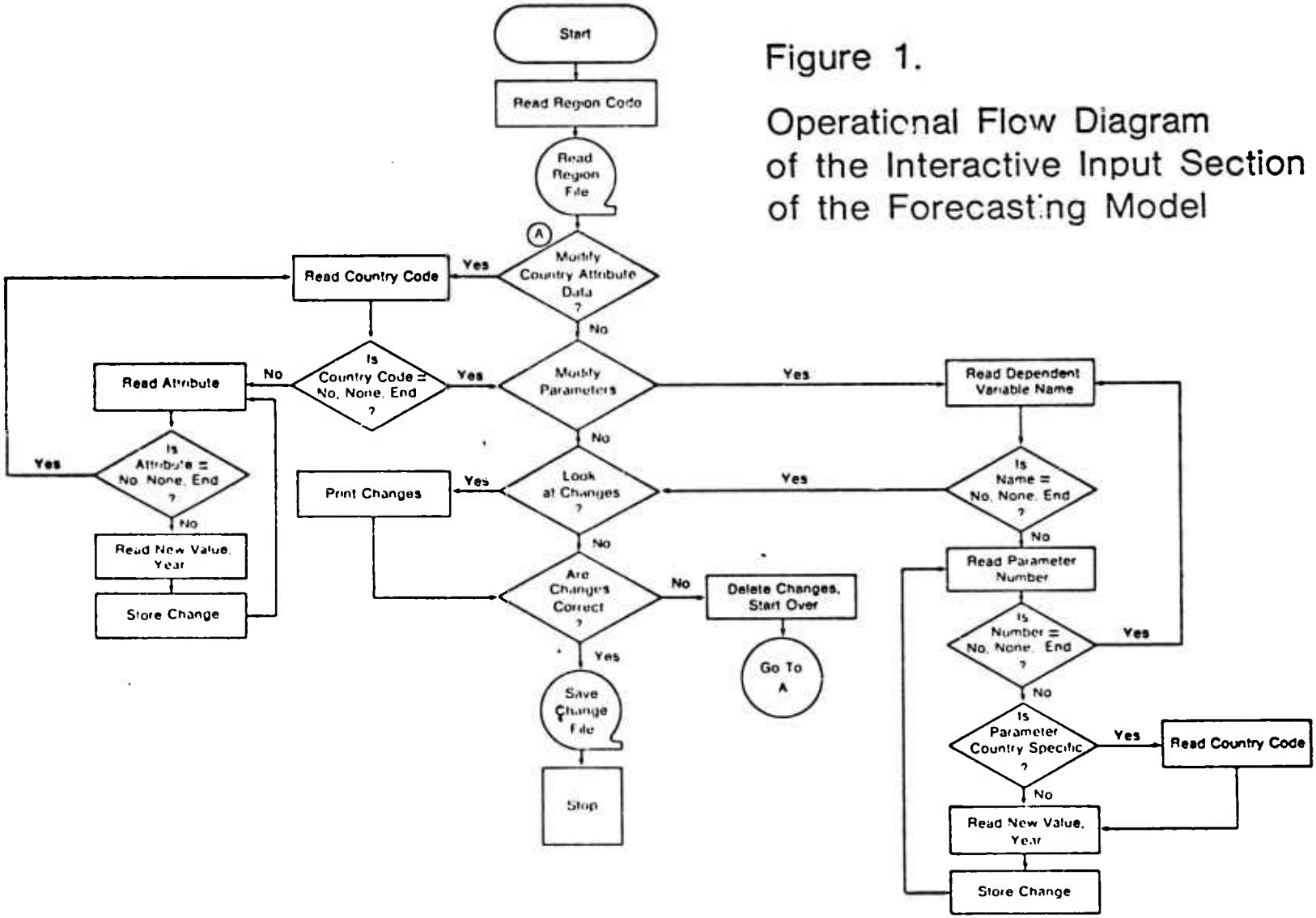

Figure 1.

Operational Flow Diagram of the Interactive Input Section of the Forecasting Model

CHAPTER 4. MODELING SOVIET FORCE EFFECTIVENESS

The second major task undertaken in this project is constructing a model that can assess Soviet total force effectiveness using information produced in the Defense Intelligence Projections for Planning Document (DIPP), currently stored in the Defense Intelligence Projections for Planning On-Line System (DIPPOLS). Two facets of this problem are covered in the present research effort. First, CACI reviewed and assessed major alternative approaches to evaluating the effectiveness of Soviet forces. Based on this review, a best method for modeling Soviet force effectiveness was identified and the sensitivity and effectiveness of that approach evaluated. Second, CACI will develop an interactive computer system for estimating total Soviet force effectiveness that permits analysts to produce measures of Soviet force effectiveness using information from the DIPP.

This chapter reviews CACI's progress to date in accomplishing these two research activities. The first half of the chapter reviews progress on conceptualizing and evaluating alternative approaches to assessing Soviet total force effectiveness. The components of various approaches are identified, and the strengths and weaknesses of each are assessed. The second half of the chapter presents activities directed toward structuring a model of Soviet total force effectiveness based on the DIPP data that can operate on U.S. Government computers. Finally, a summary section recapitulates progress to date and briefly discusses the directions to be followed in completing this task.

APPROACHES TO ASSESSING SOVIET FORCE EFFECTIVENESS

Three major efforts have been undertaken to identify and evaluate several alternative approaches to Soviet total force effectiveness.

1. The conceptual basis for a total force effectiveness model that is consistent with the information presented

in the DIPPOLS as drawn from the DIPP Document has been identified.

2. The factors that contribute to Soviet force effectiveness have been identified and defined in operational terms.

3. The best method for measuring Soviet force effectiveness has been identified, and an evaluation of the sensitivity of the various effectiveness measures has been undertaken.

To establish a conceptual framework within which Soviet total force effectiveness could be researched and modeled, CACI investigated major sections of the DIPP Document to understand the structure, format, and content of the DIPPOLS. This review suggested two fundamental approaches to a Soviet total force effectiveness assessment.

1. A key missions approach in which Soviet forces are allocated by the mission the forces must complete, counterbalanced by a judgment on the opposition those forces would meet, and the allocation of forces described by the DIPP for successful accomplishment of each mission.

2. A common currency approach for evaluating force effectiveness that would be applicable across all forces and DIPP sections describing Soviet forces.

The Key Missions Approach

This approach demands that considerable judgment be used in assessing force effectiveness by establishing major Soviet missions and war systems in order to distribute appropriate forces to each. Force effectiveness depends on the analyst's judgment of the way forces will be applied and an evaluation of the effectiveness of defense forces (for example, of the United States) to counter Soviet military efforts. Thus, the missions approach requires an assessment of the effectiveness of U.S. defense forces to evaluate Soviet force effectiveness accurately. This approach, therefore, appears to go far beyond that which is required for

assessing force effectiveness from the Defense Intelligence Agency/ Directorate for Estimates (DIA/DE) perspective. As a consequence, it was rejected as overly elaborate for current DIA/DE needs.

The Common Currency Approach

Identifying a common currency for assessing force effectiveness has far greater appeal for intelligence estimates. However, the evaluation of force effectiveness by identifying a common measure, or currency, presents the analyst with a problem of how to combine the forces into common units. In addition, it can present the analyst with other conceptual problems, such as defining operational boundaries. Does it make sense to consider simply the absolute payload of a strike aircraft independent of its range capability, maintainability, or survivability? Should the analyst focus on a subset of factors that deal directly with the lethality of a weapon, or weapons system, and contribute indirectly to its lethality?

In consultation with DIA/DE staff, the latter of these two approaches was selected as most appropriate. Specifically, CACI agreed to base model development on the common currency approach and to assess Soviet total force effectiveness based on weapons system lethality that is, in turn, based on system accuracy and survivability. These latter two factors are considered "direct lethality factors." All others -- such as reliability, range, maintenance, and logistics -- are considered indirect or "contributing" factors.[1]

- Lethality of a weapon refers to its ability to inflict damage, that is, kill personnel or make materiel ineffective in a given period of time.

- Accuracy refers to the probability that a single blow, aimed precisely at a target, will hit it with maximum lethality.

[1] Each of the following three definitions is, in whole or in part, derived from Dupuy (1976).

- Survivability refers to several factors of which mobility, vulnerability, and reliability enable a weapon to withstand damage and remain operational.

These terms describe conceptual categories, each of which consists of several variables. For example, survivability consists of mobility, vulnerability, and reliability, each of which can be measured. When combined, these conceptual categories yield a measure of "force lethality." Force lethality refers to the total lethality of each Soviet force described in the separate DIPP sections. For example, the total force lethality of Soviet long-range air can be evaluated by measuring the lethality of all Soviet long-range strike aircraft. Therefore, force lethality is an index that combines lethality, accuracy, and survivability of the systems within a particular force.

Force Lethality Index (FLI) = Lethality x Accuracy x Survivability

Force Lethality Indices, therefore, will combine measures of these three components into a single measure for each major Soviet force component -- strategic offense, long-range air, general purpose forces, and so forth. The individual FLI's can be aggregated to generate a total Soviet force effectiveness index. Furthermore, because specific applications of military power invariably require a mixture of forces, CACI will develop its model to permit FLI's for typical Soviet force structures to be generated. For example, FLIs for Soviet strategic intercontinental capability that combine the lethalities of strategic offensive missles and long-range bombers is of particular interest to DIA/DE. At the same time, Soviet capability to defend its periphery with tactical air power and general purpose forces suggests that an FLI for such a force mix would be extremely useful to support intelligence estimates.

Force lethality is a measure of the capability of a weapons system to inflict damage. Such indices do not take into account the many contributing factors (both positive and negative) that affect the lethality of

a given weapons system. Both CACI and DIA/DE recognize the difficulty of including numerous constraining factors whose operationalization is, to a considerable extent, judgmental. An explicit statement of such factors, and the assumptions underlying them, will be included in user documentation so that all analysts will be aware of the limits of the total force effectiveness calculations. Guidelines for specifying assumptions about targeting, range, target vulnerability, and attack scenarios will also be made available.

The formulation adopted for assessing Soviet total force effectiveness in this project draws heavily on previous work to evaluate the operational impact of different weapons and force mixes. The most important of these is developmental work by Dupuy (1976) and Thomas and Anjier (1973). Using historical data, Dupuy found that a combined index with many of the components that are to be included in the total Soviet force effectiveness model proposed here produces consistently accurate postdictions of the outcomes of battles in World Wars I and II and the Korean war. Thomas and Anjier evaluated a number of measures of force effectiveness, including some of the classic firepower measures from the early attempts at computer assessment of combat. They concluded that a model with characteristics similar to that proposed for this effort was as accurate and sensitive as any other measure (including some that were appreciably more complex). Whether measures developed along the lines discussed in this section are adequately sensitive (once real and projected Soviet force data are incorporated) will be tested as the interactive computer system is developed. Based on historical data, however, there is every reason to expect accurate and sensitive results.

DEVELOPING AN INTERACTIVE COMPUTER SYSTEM FOR ESTIMATING TOTAL SOVIET FORCE EFFECTIVENESS

Once the conceptual approaches to assessing Soviet force effectiveness were identified, CACI and DIA/DE personnel discussed interfacing the

Soviet force effectiveness model and the DIPPOLS system. In consultation with DIA/DE, the CACI research staff has

- Identified the basic program structure for the Soviet total force effectiveness model as a module to be interfaced with the existing DIPPOLS.
- Identified the need for a simulation capability with which defense intelligence analysts can manipulate Soviet force composition and evaluate the impact of force structure on force effectiveness.
- Identified the need to implement three sets of initial parameters that describe the high, best, and low force effectiveness projections based on the DIPP Document.
- Established the procedures for user interaction with the total Soviet force effectiveness model that permit the analyst to (1) load appropriate data into a working space, (2) query the system for specific details, (3) simulate new configurations and sizes of forces, and (4) simulate the introduction of new weapons systems.
- Studied the role of the DIPPOLS, currently accessible by DIA/DE, and the "conversion factors" developed by DIA/DE for transforming, aggregating, and segregating specific portions of the DIA/DE Soviet forces data base in estimating Soviet force effectiveness.
- Established that the Soviet force effectiveness model should permit the combination of strategic, general purpose, and long-range lethality indices to generate a summary index for each major force category.

The decision to work on an index of lethality as the primary component of force effectiveness has crucial consequences. First, only weapons systems that have inherent lethality (such as artillery, missile cruisers, or bombers) will enter directly with the force effectiveness calculations. This does not, however mean that support systems (including tankers, reconnaissance aircraft, and improved transport for ground forces) will be ignored. Nor does it imply that qualitative improvements in weapons system's lethality (improved mobility, lower fuel consumption, improved radars, and so forth) will be ignored.

Both qualitative changes in lethal weapons systems and the contribution of non-lethal systems are considered through their influence on the primary variables, lethality, survivability, and accuracy. For example, one relatively straightforward weapons system to deal with is an intercontinental ballistic missile (ICBM). Presume that for a given type of ICBM, the lethality is 20 kilotons (KT). Given its estimated mechanical reliability, an assumption that it is targeted on a city that lacks an effective anti-ballistic missile (ABM), and a presumption that it is used in a "first strike," the ICBM might be given a 0.80 probability of surviving long enough to accomplish its mission. If 60 such missles exist, 50 of which are armed with warheads -- the others carrying electronic countermeasures (EW) -- and their accuracy (or probability of hitting their targets, given survival) is 0.80 the force effectiveness equation would be

50 armed missiles x 20KT lethality x 0.80 accuracy x 0.80 survivability = 640KT.

Thus,

FLI = 640KT.

Note that a change in the EW missles that help guide the warhead missiles to their targets more accurately (increasing accuracy to .90, for example) would reflect in increased force effectiveness because it influences the FLI through the accuracy coefficients. Given this capacity to influence the FLI score in several ways, the definitions of lethality, accuracy and survivability used in this part of the project (see pages 4-3 and 4-4) are critical. If time and the available level of effort permit, survivability will be extended to apply to the probability of a weapons system to remain functional after 24 hours on the battlefield when facing the best enemy forces and equipment, excluding consumable weapons systems such as missiles. This second definition of survivability would not, however measure growth in Soviet forces unless they were not countered by improvements in opposing forces. It also greatly complicates the calculations.

The role of EW, logistics, intelligence, mobility, command, control, and communications (C^3) and other crucial items have been subordinated to firepower. Firepower has been emphasized in utilizing a lethality index. However, since the primary goal of military forces is to place firepower on targets, the current treatment was determined in consultation with DIA/DE to be a good starting place for effectiveness modeling. Once the basic system has been implemented, more elaborate treatments can be undertaken. Among those elaborations that should be considered are:

- Calculating different FLI's for alternative missions;
- Calculating survivability both for battlefield entry and for the 24 hour life expectancy; and
- Calculating force effectiveness for specific types of missions.

In the interim, the DIA analysts will be able to construct these alternative force effectiveness indices through the use of the interactive computer software. The analysts will, of course, have to generate their own measures of survivability and accuracy for these exercises. With this computer assisted manipulation, however, the capability of DIA/DE analysts to assess the total effectiveness of Soviet forces will be considerably enhanced.

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APPENDIX A

COUNTRY LIST

Latin America n = 21

Argentina	Dominican Republic	Mexico
Bolivia	Ecuador	Nicaragua
Brazil	El Salvador	Panama
Chile	Guatemala	Paraguay
Colombia	Haiti	Peru
Costa Rica	Honduras	Uruguay
Cuba	Jamaica	Venezuela

Africa n = 29

Burundi	Ivory Coast	Senegal
Cameroon	Kenya	Sierra Leone
Central African Republic	Liberia	Somalia
Chad	Malagasy	South Africa
People's Republic of Congo	Malawi	Tanzania
Dahomey	Mali	Uganda
Ethiopia	Niger	Upper Volta
Gambia	Nigeria	Zaire
Ghana	Rhodesia	Zambia
Guinea	Rwanda	

Middle East n = 15

Algeria	Jordan	Saudi Arabia
Egypt	Kuwait	Sudan
Iran	Lebanon	Syria
Iraq	Libya	Tunisia
Israel	Morocco	Yemen

Europe n = 25

Finland	West Germany	Greece
Sweden	France	Turkey
Norway	United Kingdom	Yugoslavia
Denmark	Ireland	Poland
Iceland	Switzerland	East Germany
Austria	Portugal	Hungary
Belgium-Luxembourg	Spain	Czechoslovakia
Netherlands	Italy	Rumania

APPENDIX B

VARIABLE LIST AND IDENTIFICATION AND DATA SOURCES

Variable Name	Abbreviation	Years	Sources
Population	POP	1960 1965 1970	ACDA (1976) China population (CHPOP) from U.S. Congress, Joint Economic Committee (1975)
Gross Domestic Product	GDP	1960-1970	For Africa, Latin America, and Middle East regions, data are from United Nations (1955-1975) and International Monetary Fund (IMF) (1955-1975). Data are lacking for four African countries. For Europe, data are from Organization for Economic Cooperation and Development (OECD) (1975) and U.S. Congress, Joint Economic Committee (1973). Data for East Europe are adjusted. China data are from U.S. Congress, Joint Economic Committee (1975).
Defense Expenditures	DEFEX	1965-1970	ACDA (1976)
Turmoil	TML	1969, 1970	Gurr (1970), magnitude of political violence variable for developing regions. Banks (1970) "anti-government demonstrations and riots" for Europe.
Coup	COUP	1955-1970	Banks (1970). Data are irregular government transfers for Africa, Latin America, and the Middle East. No data for Europe.
Military Manpower	MILMAN	1969-1970	ACDA (1976)

Variable Name	Abbreviation	Years	Sources
Government Type	GOVT	1970	Coded by Hayes: (1) = Western European-type democracy (2) = East European-type Communist regime (3) = Modernizing authoritarian (4) = Populist democracy (5) = Traditional elitist authoritarian
Bloc Identification	BLOC	1965, 1970	Coded by McIlroy from Rummel (1972): +1 = U.S. alliances 0 = neutral -1 = Soviet alliances
Total Imports Total Exports	TIM TEX	1965-1970	IMF (1955-1975)
Arms Transfers From the United States, Soviet Union	UST SUT	1963-1973 aggregated	ACDA (1976). Data for Europe are sales, not transfers.
Total Consumption (Public and Private)	CONS	1960-1970	For Africa, Latin America, and the Middle East, data are from United Nations (197 . For Western Europe, data are from OECD (1974). For Eastern Europe, data are from U.S. Congress, Joint Economic Committee (1973) and United Nations (1955-1975).

Variable Name	Abbreviation	Years	Sources
Exports to Soviet Union	TEXSU	1960-1970	IMF (1955-1975) United Nations (1955-1975) OECD (1955-1975)
Imports From Soviet Union	TIMSU	1960-1970	
Exports to United States	TEXUS	1960-1970	
Imports From United States	TIMUS	1960-1970	
Exports to China	TEXCH	1960-1972	
Imports From China	TIMCH	1960-1972	
Cooperative Behavior From Superpowers	SPCOOP	1970	Calculated from World Events Interaction Survey (WEIS) data.
Defense Spending by Most Salient Rival(s)	RIVDEFX	1970	Rivals identified from historical patterns and analyses of current relationships. In most instances, only one or two countries are identified as rivals. For Europe, both individual country rivals and rival alliances are identified. Defense spending by rivals is calculated from country data files.
Soviet Military Assistance	SUM	1960-1970	Data for Africa, Latin America, and the Middle East are from Stockholm International Peace Research Institute (SIPRI)

Variable Name	Abbreviation	Years	Sources
			(1971), U.S. Department of State (1965-1975), and ACDA (1976). Europe data are from ACDA and are arms "delivered" under both grant and sales agreements.
Soviet Economic Aid	SUA	1960-1970	Compiled from U.S. Department of State (1965-1975), Goldman (1967), Tansky (1973), and U.S. Congress, Joint Economic Committee (1973).
China Economic Aid	CHA	1960-1970	
China Military Assistance	CHM	1960-1970	U.S. Department of State (1965-1975)
U.S. Military Assistance	USMAID	1960-1970	Data for Africa, Latin America, and the Middle East are from AID (1974). Data for Europe are from ACDA (1976). Data represent deliveries under grant and purchase agreements.
U.S. Economic Aid	USA	1960-1970	AID (1974)
Gross Fixed Domestic Capital Formation	INV	1960-1970	United Nations (1955-1975)

Variable Name	Abbreviation	Years	Sources
U.N. Voting Data Votes With United States Votes With Soviet Union Votes With China	VOTE	1969-1971	Office of Current Intelligence, Central Intelligence Agency (1976)
International Conflict	CONF	1969-1972	Annual values calculated from weighted WEIS data. For WEIS variables and weighting factors, see CACI (1974: 360).
Strain (Societal, Regional Disequilibria)	STRAIN	1970	Calculated for Africa, Latin America, and the Middle East as $\left(\frac{GDP_t}{POP_t} - \%\ \text{nonagriculture employment}\right) + \left(\frac{GDP_t}{POP_t} - \%\ \text{literate}\right)$ $+ \left(\%\ \text{nonagriculture employment} - \%\ \text{urban population}\right)$
	RELDEP	1970	Calculated for Europe as $\frac{\sum \frac{GDP}{POP}}{N} - \frac{GDP_i}{POP_i}$
Revolt Against Government Institutions	RVLT	1955-1970	Banks (1970). Armed attacks against public and quasi-public institutions. Europe only.

APPENDIX C

PARAMETERS FOR THE FORECASTING MODEL, BY REGION

INTRODUCTION

Two sets of tables are presented in this appendix. The first set, Table 3 and 6 present the country-specific economic parameters for all of the nations in the current study (90), derived from time-series analysis exports, imports, investment, and consumption. Because the parameters were generated from lagged, auto-regressive time-series or from compound growth calculation, they can be interpreted as compound growth rates.

The next set of tables, Table 1-2, 4-5, 7-14, present all cross-sectional analyses. All information necessary for evaluating the results are presented. While all results remain tentative at this time, they will guide analysts in re-structuring of the actual forecasting model.

TABLE 1

Region-Specific Parameters for
Four Regions for Total Imports

Dependent Variable: TIM	Region: Europe			Number of Cases: 123
Independent Variables	Simple r	β	B	Standard Error of B
ATIM	.98	0.98	1.08	0.017
Constant			69.54	
Multiple R: .98	Standard Error: 968.98		Degrees of Freedom	
Multiple R^2: .97	F-level: 4022.52		Regression: 1	
	Significance: p <.01		Residual: 121	

Dependent Variable: TIM	Region: Middle East			Number of Cases: 99
Independent Variables	Simple r	β	B	Standard Error of B
ATIM	.965	.965	1.10	0.04
Constant			-3.70	
Multiple R: .965	Standard Error: 90.4		Degrees of Freedom	
Multiple R^2: .932	F-level: 913.65		Regression: 1	
	Significance: p <.001		Residual: 97	

Dependent Variable: TIM	Region: Latin America			Number of Cases: 100
Independent Variables	Simple r	β	B	Standard Error of B
ATIM	.99	0.99	1.12	0.02
Constant			-10.86	
Multiple R: .99	Standard Error: 92.1		Degrees of Freedom	
Multiple R^2: .98	F-level: 4756.5		Regression: 1	
	Significance: p <.001		Residual: 98	

Dependent Variable: TIM	Region: Africa			Number of Cases: 97
Independent Variables	Simple r	β	B	Standard Error of B
ATIM	.99	0.99	1.09	0.01
Constant			-3.87	
Multiple R: .991	Standard Error: 81.3		Degrees of Freedom	
Multiple R^2: .983	F-level: 5434.7		Regression: 2	
	Significance: p <.001		Residual: 94	

TABLE 2

Region-Specific Parameters for
Four Regions on Total Exports

Dependent Variable: TEX	Region: Europe			Number of Cases: 123
Independent Variables	Simple r	β	B	Standard Error of B
ATEX	-.13	-0.13	-0.13	0.089
Constant			15005.36	
Multiple R: .13	Standard Error: 20145.4			Degrees of Freedom
Multiple R^2: .01	F-level: 2.17			Regression: 1
	Significance: p < .05			Residual: 121

Dependent Variable: TEX	Region: Middle East			Number of Cases: 75
Independent Variables	Simple r	β	B	Standard Error of B
ATEX	.97	0.97	1.17	0.03
Constant			-34.40	
Multiple R: .975	Standard Error: 172.0			Degrees of Freedom
Multiple R^2: .952	F-level: 1435.96			Regression: 1
	Significance: p <.001			Residual: 73

Dependent Variable: TEX	Region: Latin America			Number of Cases: 99
Independent Variables	Simple r	β	B	Standard Error of B
ATEX	.98	0.98	1.04	0.01
Constant			14.27	
Multiple R: .991	Standard Error: 98.1			Degrees of Freedom
Multiple R^2: .983	F-level: 5634.6			Regression: 1
	Significance: p <.001			Residual: 97

Dependent Variable: TEX	Region: Africa			Number of Cases: 140
Independent Variables	Simple r	β	B	Standard Error of B
ATEX	.99	.99	1.07	0.01
Constant			3.34	
Multiple R: .99	Standard Error: 59.39			Degrees of Freedom
Multiple R^2: .98	F-level: 6542.2			Regression: 1
	Significance: p <.001			Residual: 138

TABLE 3

Compound Growth Rates
for Imports and Exports in Europe
(1955-1970 unless otherwise noted)

Country	Imports	Exports
United Kingdom	1.0476	1.0574
Austria	1.0968	1.0984
Belgium-Luxembourg	1.0971	1.1001
Denmark	1.0919	1.0800
France	1.0974	1.0908
West Germany	1.1154	1.1213
Italy	1.1206	1.1397
Netherlands	1.1001	1.1035
Norway	1.0849	1.0946
Sweden	1.0873	1.0957
Switzerland	1.1031	1.0955
Finland	1.0856	1.0742
Greece	1.1150	1.0873
Iceland	1.0477	1.0717
Ireland	1.0707	1.0892
Portugal	1.0967	1.0836
Spain	1.1452	1.1183
Turkey	1.0438	1.0430
Yugoslavia	1.1331	1.1333
Poland[a]	1.0918	1.1034
East Germany[a]	1.0836	1.0765
Hungary[a]	1.0988	1.1024
Czechoslovakia[a]	1.0736	1.0744
Rumania[a]	1.1170	1.2945
Bulgaria	--	--

[a] Data are from 1960-1970.

TABLE 3 (Cont'd.)

Compound Growth Rates
for Imports and Exports in the Middle East
(1955-1970 unless otherwise noted)

Country	Imports	Exports
Egypt	1.0255	1.0407
Iran	1.1220	1.1309
Iraq	1.0427	1.0513
Israel	1.1022	1.1536
Jordan	1.0607	1.1013
Kuwait	1.1163	1.0609
Lebanon	1.0648	1.1214
Saudi Arabia	1.0718	1.0863
Syria	1.0477	1.0231
Yemen	1.3312[a]	1.2121[a]
Algeria	1.0401	1.0533
Libya	1.1915	1.4147
Morocco	1.0215	1.0268
Tunisia	1.0356	1.0360
Sudan	1.0493	1.0492

[a] Data are from 1966-1970.

TABLE 3 (Cont'd.)

Compound Growth Rates
for Exports and Imports in Latin America
(1955-1970 unless otherwise noted)

Country	Imports	Exports
Argentina	1.0248	1.0440
Bolivia	1.0455	1.0753
Brazil	1.0534	1.0446
Chile	1.0623	1.0669
Colombia	1.0156	1.0156
Costa Rica	1.0900	1.0724
Cuba	--	--
Dominican Republic	1.0683	1.0423
Ecuador	1.0529	1.0442
El Salvador	1.0579	1.0520
Guatemala	1.0679	1.0709
Haiti	1.0107	1.0070
Honduras	1.0884	1.0840
Jamaica	1.0982	1.0900
Mexico	1.0705	1.0375
Nicaragua	1.0721	1.0610
Panama	1.0978	1.0773
Paraguay	1.0551	1.0410
Peru	1.0476	1.0949
Uruguay	1.0011	1.0162
Venezuela	1.0431	1.0235

TABLE 3 (Cont'd)

Compound Growth Rates
for Imports and Exports in Africa
(1955-1970 unless otherwise noted)

Country	Imports	Exports
Burundi	0.9852[a]	1.1696[a]
Cameroon	1.0579	1.0613
Central African Republic	0.9472[a]	0.9513[a]
Chad	1.0471[a]	0.9891[a]
People's Republic of Congo	0.8520[a]	0.8527[a]
Dahomey	1.0857[a]	1.1447[a]
Ethiopia	1.0681	1.0397
Gambia	0.9499[a]	1.0395[a]
Ghana	1.0348	1.0393
Guinea	1.1597[a]	1.0185
Ivory Coast	1.0730[a]	1.1251[a]
Kenya	1.0468	1.0706
Liberia	1.1239	1.1129
Malagasy	1.0000[a]	1.0848[a]
Malawi	1.0781[a]	1.0909[a]
Mali	1.0071[a]	1.2239[a]
Niger	1.1225[a]	1.0333[a]
Nigeria	1.0705	1.0838
Rhodesia	0.9267[b]	0.9267[b]
Rwanda	1.0803[a]	1.1856[a]
Senegal	1.0233[a]	1.0459[b]
Sierra Leone	1.0606	1.0882

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[a] Data are from 1968-1970.

[b] Data are from 1963-1970.

[c] Data are from 1964-1970.

(Continued)

Somalia	1.0000[b]	0.9954[b]
South Africa	1.0495	1.0656
Tanzania	1.0735[a]	1.0421[b]
Uganda	1.0168	1.0508
Upper Volta	1.0435[a]	0.9499[a]
Zaire	1.1889[a]	1.1140[b]
Zambia	1.0155[a]	1.1342[c]

---

[a] Data are from 1968-1970.

[b] Data are from 1963-1970.

[c] Data are from 1964-1970.

TABLE 4

Region-Specific Parameters for
Four Regions on Consumption

Dependent Variable: CONS	Region: Europe			Number of Cases: 220
Independent Variables	Simple r	β	B	Standard Error of B
ACONS	.99	0.99	1.07	0.006
Constant			114.46	
Multiple R: .99	Standard Error: 1820.86		Degrees of Freedom	
Multiple R^2: .99	F-level: 29073.4		Regression: 1	
	Significance: p <.01		Residual: 218	

Dependent Variable: CONS	Region: Middle East			Number of Cases: 128
Independent Variables	Simple r	β	B	Standard Error of B
ACONS	.99	0.99	1.07	0.009
Constant			21.08	
Multiple R: .99	Standard Error: 135.0		Degrees of Freedom	
Multiple R^2: .99	F-level: 12694.9		Regression: 1	
	Significance: p <.01		Residual: 126	

Dependent Variable: CONS	Region: Latin America			Number of Cases: 156
Independent Variables	Simple r	β	B	Standard Error of B
ACONS	.99	0.99	1.11	0.005
Constant			-38.32	
Multiple R: .99	Standard Error: 221.6		Degrees of Freedom	
Multiple R^2: .99	F-level: 45659.9		Regression: 1	
	Significance: p <.01		Residual: 154	

Dependent Variable: CONS	Region: Africa			Number of Cases: 181
Independent Variables	Simple r	β	B	Standard Error of B
ACONS	.99	0.99	1.08	0.005
Constant			-4.16	
Multiple R: .99	Standard Error: 114.8		Degrees of Freedom	
Multiple R^2: .99	F-level: 42080.6		Regression: 1	
	Significance: p <.01		Residual: 179	

TABLE 5

Region-Specific Parameters for Four Regions on Investment

Dependent Variable: INV	Region: Europe			Number of Cases: 220
Independent Variables	Simple r	β	B	Standard Error of B
AINV	.99	0.99	1.09	0.009
Constant			-16.83	
Multiple R: .99 Multiple R^2: .98	Standard Error: 1051.2 F-level: 13589.9 Significance: p <.01		Degrees of Freedom Regression: 1 Residual: 218	

Dependent Variable: INV	Region: Middle East			Number of Cases: 128
Independent Variables	Simple r	β	B	Standard Error of B
AINV	.97	0.97	1.11	0.02
Constant			3.74	
Multiple R: .97 Multiple R^2: .95	Standard Error: 85.2 F-level: 2667.9 Significance: p <.01		Degrees of Freedom Regression: 1 Residual: 126	

Dependent Variable: INV	Region: Latin America			Number of Cases: 153
Independent Variables	Simple r	β	B	Standard Error of B
AINV	.99	0.99	1.10	0.007
Constant			-0.86	
Multiple R: .99 Multiple R^2: .99	Standard Error: 106.92 F-level: 20701.0 Significance: p <.01		Degrees of Freedom Regression: 1 Residual: 151	

Dependent Variable: INV	Region: Africa			Number of Cases: 189
Independent Variables	Simple r	β	B	Standard Error of B
AINV	.99	0.99	1.12	0.009
Constant			0.65	
Multiple R: .99 Multiple R^2: .98	Standard Error: 68.2 F-level: 15661.9 Significance: p <.01		Degrees of Freedom Regression: 1 Residual: 187	

DIA TABLE 6 (INTERIM TECHNICAL REPORT)

REVISED 7/23/76

TABLE 6

Country-Specific Parameters
for Europe on Investment and Consumption

Country	Investment	Consumption
United Kingdom[a]	1.0752	1.0586
Austria[a]	1.0967	1.0818
Belgium-Luxembourg[a]	1.0677	1.0958
Denmark[a]	1.1142	1.0458
France[a]	1.1017	1.0679
West Germany[a]	1.0987	1.1012
Italy[a]	1.0966	1.0996
Netherlands[a]	1.1166	1.0981
Norway[a]	1.0339	1.0810
Sweden[a]	1.0916	1.0813
Switzerland[a]	1.1098	1.0767
Finland[a]	1.0615	1.0577
Greece[a]	1.1338	1.0917
Iceland[a]	1.0387	1.0395
Ireland[a]	1.0833	1.0766
Portugal[a]	1.0933	1.0859
Spain[a]	1.0898	1.0821
Turkey[a]	1.0351	1.0203
Yugoslavia[d]	1.0281	1.0271
Poland[d]	1.0557	1.1458
East Germany[d]	1.1854	1.1126
Hungary[d]	1.4527	1.0964
Czechoslovakia[d]	1.2408	1.0569
Rumania[d]	1.1187	1.1649
Bulgaria[d]	-0.1807	1.1318

---

[a] Data are from 1955-1970.

[b] Data are from 1956-1970.

[c] Data are from 1959-1970.

[d] Data are from 1960-1970.

[e] Data are from 1960-1968.

[f] Data are from 1961-1970.

[g] Data are from 1962-1970.

[h] Data are from 1963-1969.

[i] Data are from 1963-1970.

[j] Data are from 1964-1970.

[k] Data are from 1965-1968.

[l] Data are from 1966-1971 for national income (instead of consumption and investment). Data for consumption and investment are only available for much shorter time periods.

TABLE 6 (Cont'd.)

Country-Specific Parameters for the Middle East
on Investment and Consumption

Country	Investment	Consumption
Egypt[d]	1.0975	1.1062
Iran[c]	1.1156	1.0962
Iraq[a]	1.0611	1.0880
Israel[a]	0.9353	1.1082
Jordan[b]	1.0384	1.0658
Kuwait[g]	1.0879	1.0770
Lebanon[j]	1.0414	1.0589
Saudi Arabia[g]	1.1041	1.1114
Syria[d]	1.0787	1.0741
Yemen	---	---
Algeria[a]	1.1095	1.0628
Libya[g]	1.1961	1.1799
Morocco[a]	1.0571	1.0356
Tunisia[d]	1.0677	1.0475
Sudan[b]	1.0528	1.0371

---

[a] Data are from 1955-1970.

[b] Data are from 1956-1970.

[c] Data are from 1959-1970.

[d] Data are from 1960-1970.

[e] Data are from 1960-1968.

[f] Data are from 1961-1970.

[g] Data are from 1962-1970.

[h] Data are from 1963-1969.

[i] Data are from 1963-1970.

[j] Data are from 1964-1970.

[k] Data are from 1965-1968.

[l] Data are from 1966-1971 for national income (instead of consumption and investment). Data for consumption and investment are only available for much shorter time periods.

TABLE 6 (Cont'd.)

Country-Specific Parameters for
Latin America on Investment and Consumption

Country	Investment	Consumption
Argentina[a]	1.1211	1.1159
Bolivia[a]	1.0878	1.1213
Brazil[a,c]	1.1253	1.1466
Chile[a]	1.1665	1.1407
Colombia[a]	1.0304	1.0140
Costa Rica[a]	1.0755	1.0792
Cuba	---	---
Dominican Republic[a]	1.0591	1.0725
Ecuador[a]	1.1109	1.0847
El Salvador[a]	1.0673	1.0453
Guatemala[a]	1.0757	1.0569
Haiti[d]	0.9046	1.0484
Honduras[a]	1.0826	1.0577
Jamaica[a]	1.1408	1.0901
Mexico[a]	1.1332	1.1072
Nicaragua[a]	1.0796	1.0655
Panama[a]	1.1453	1.0690
Paraguay[g]	1.0789	1.0486
Peru[a]	1.0667	1.0979
Uruguay[a]	1.0410	1.0542
Venezuela[a]	1.0421	1.0545

---

[a] Data are from 1955-1970.

[b] Data are from 1956-1970.

[c] Data are from 1959-1970.

[d] Data are from 1960-1970.

[e] Data are from 1960-1968.

[f] Data are from 1961-1970.

[g] Data are from 1962-1970.

[h] Data are from 1963-1969.

[i] Data are from 1963-1970.

[j] Data are from 1964-1970.

[k] Data are from 1965-1968.

[l] Data are from 1966-1971 for national income (instead of consumption and investment). Data for consumption and investment are only available for much shorter time periods.

TABLE 6 (Cont'd.)

Country-Specific Parameters for Africa
on Investment and Consumption

Country	Investment	Consumption
Burundi	--	--
Cameroon[b]	1.0778	1.0581
Central African Republic	--	--
Chad	--	--
People's Republic of Congo	--	--
Dahomey[k]	0.1900	0.8939
Ethiopia[f]	1.0669	1.0679
Gambia	--	--
Ghana[a]	1.0409	1.0622
Guinea	--	--
Ivory Coast[e]	1.1374	1.1480
Kenya[j]	1.1684	1.0789
Liberia[l]	1.0625	1.0625
Malagasy	--	--
Malawi[a]	1.1083	1.0827
Mali	--	--
Niger[h]	0.9385	1.0797
Nigeria	1.1257	1.0858
Rhodesia	0.9536	1.1984
Rwanda	--	--
Senegal	0.9391	1.0037
Sierra Leone[i]	1.0731	1.0457
Somalia	--	--
South Africa[a]	1.1029	1.0860
Tanzania[j]	1.0894	0.9204
Uganda	--	--
Upper Volta[k]	0.9826	1.1308
Zaire[d]	1.0171	1.0337
Zambia[a]	1.0932	1.0973

---

[a] Data are from 1955-1970.

[b] Data are from 1956-1970.

[c] Data are from 1959-1970.

[d] Data are from 1960-1970

[e] Data are from 1960-1968.

[f] Data are from 1961-1970.

[g] Data are from 1962-1970.

[h] Data are from 1963-1969.

[i] Data are from 1963-1970.

[j] Data are from 1964-1970.

[k] Data are from 1965-1968.

[l] Data are from 1966-1971 for national income (instead of consumption and investment). Data for consumption and investment are only available for much shorter time periods.

TABLE 7

Region-Specific Parameters of Superpower-to-Region Imports

Dependent Variable: TIMUS	Region: Europe			Number of Cases: 42
Independent Variables	Simple r	B	B	Standard Error of B
GDP_i	.88	0.51	0.10	0.24
VOTEUS	.67	0.39	137.43	23.88
POP_i	.73	0.22	95.27	47.74
Constant			-5945.38	
Multiple R: .93	Standard Error: 2587.05			Degrees of Freedom
Multiple R^2: .88	F-level: 93.54			Regression: 3
	Significance: p <.01			Residual: 38

Dependent Variable: TIMUS	Region: Latin America			Number of Cases: 40
Independent Variables	Simple r	B	B	Standard Error of B
GDP_i	.85	1.61	0.055	0.61
USGNP	.05	0.36	0.0045	0.00
POP_i	.71	-0.72	-12.83	3.01
VOTEUS	.12	-0.16	-6.61	2.84
Constant			-49.25	
Multiple R: .93	Standard Error: 143.44			Degrees of Freedom
Multiple R^2: .86	F-level: 52.45			Regression: 4
	Significance: p <.01			Residual: 35

Dependent Variable: TIMUS	Region: Middle East			Number of Cases: 29
Independent Variables	Simple r	B	B	Standard Error of B
VOTEUS	.75	0.49	5.37	.91
GDP_i	.68	0.86	0.03	.41
POP_i	.13	-0.51	-5.25	1.09
USGNP	.02	0.18	0.94	.37
Constant			-1019.12	
Multiple R: .94	Standard Error: 33.32			Degrees of Freedom
Multiple R^2: .89	F-level: 52.00			Regression: 4
	Significance: p <.01			Residual: 24

Dependent Variable: TIMUS	Region: Africa			Number of Cases: 47
Independent Variables	Simple r	B	B	Standard Error of B
GDP_i	.98	1.08	0.036	0.006
POP_i	.37	-0.20	-1.98	0.17
VOTEUS	.13	0.02	0.28	0.17
Constant			-9.97	
Multiple R: .99	Standard Error: 10.95			Degrees of Freedom
Multiple R^2: .99	F-level: 1616.31			Regression: 3
	Significance: p <.01			Residual: 43

TABLE 7 (Cont'd)

Dependent Variable: TIMSU	Region: Europe			Number of Cases: 42
Independent Variables	Simple r	β	B	Standard Error of B
VOTESU	.82	0.93	120.76	10.33
GDP_t	.02	0.30	0.03	0.008
SUGNP	.03	0.16	0.17	0.008
Constant				
Multiple R: .88	Standard Error: 1932.62			Degrees of Freedom
Multiple R^2: .78	F-level: 45.68			Regression: 3
	Significance: p <.01			Residual: 38

Dependent Variable: TIMSU	Region: Middle East			Number of Cases: 29
Independent Variables	Simple r	β	B	Standard Error of B
POP_t	.71	0.69	1.87	0.[illegible]
VOTESU	.38	0.34	0.76	0.26
Constant				
Multiple R: .79	Standard Error: 15.83			Degrees of Freedom
Multiple R^2: .63	F-level: 22.42			Regression: 2
	Significance: p <.01			Residual: 26

Dependent Variable: TIMSU	Region: Latin America			Number of Cases: 40
Independent Variables	Simple r	β	B	Standard Error of B
POP_t	.66	0.66	0.097	0.016
SUGNP	-.23	-0.19	-0.0001	0.0001
Constant			1.91	
Multiple R: .70	Standard Error: 2.13			Degrees of Freedom
Multiple R^2: .49	F-level: 17.18			Regression: 2
	Significance: p <.01			Residual: 37

Dependent Variable: TIMSU	Region: Africa			Number of Cases: 47
Independent Variables	Simple r	β	B	Standard Error of B
POP_t	.39	0.36	0.10	0.04
VOTESU	.23	0.17	0.33	0.03
Constant			-1.07	
Multiple R: .42	Standard Error: 3.01			Degrees of Freedom
Multiple R^2: .18	F-level: 4.87			Regression: 2
	Significance: p <.05			Residual: 44

TABLE 7 (Cont'd)

Dependent Variable: TIMCH	Region: Europe			Number of Cases: 34
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.95	0.95	0.0064	0.0003
CHGNP	.09	0.06	0.0015	0.0012
Constant			82.95	
Multiple R: .96	Standard Error: 82.95			Degrees of Freedom
Multiple R^2: .91	F-level: 166.31			Regression: 2
	Significance: p <.01			Residual: 31

Dependent Variable: TIMCH	Region: Middle East			Number of Cases: 26
Independent Variables	Simple r	β	B	Standard Error of B
CHGNP	.34	0.34	0.0003	0.15
Constant			-33.66	
Multiple R: .34	Standard Error: 8.36			Degrees of Freedom
Multiple R^2: .11	F-level: 3.26			Regression: 1
	Significance: p >.05			Residual: 24

Dependent Variable: TIMCH	Region: Latin America			Number of Cases: 19
Independent Variables	Simple r	β	B	Standard Error of B
VOTOCH	.26	0.26	0.39	0.035
Constant			-0.66	
Multiple R: .26	Standard Error:			Degrees of Freedom
Multiple R^2: .07	F-level:			Regression: 1
	Significance: p >.05			Residual: 17

Dependent Variable: TIMCH	Region: Africa			Number of Cases: 30
Independent Variables	Simple r	β	B	Standard Error of B
POP_i	.30	0.30	0.44	0.26
Constant			5.47	
Multiple R: .30	Standard Error: 19.05			Degrees of Freedom
Multiple R^2: .09	F-level: 2.93			Regression: 1
	Significance: p >.05			Residual: 28

TABLE 8

Region-Specific Parameters for
Superpower-to-Region Exports

Dependent Variable: TEXUS	Region: Europe			Number of Cases: 42
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.83	0.40	0.56	0.02
VOTEUS	.64	0.39	100.81	21.80
POP_i	.72	0.29	93.49	43.57
Constant			-4558.94	

Multiple R: .90	Standard Error: 2360.98	Degrees of Freedom
Multiple R^2: .81	F-level: 54.56	Regression: 3
	Significance: p <.01	Residual: 38

Dependent Variable: TEXUS	Region: Latin America			Number of Cases: 42
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.72	1.52	0.45	0.08
USGNP	.15	0.45	0.50	0.0012
POP_i	.61	-0.74	-114.38	38.20
VOTEUS	.09	-02 0	-74.08	36.05
Constant			-495.36	

Multiple R: .83	Standard Error: 1821.56	Degrees of Freedom
Multiple R^2: .70	F-level: 20.81	Regression: 4
	Significance: p <.01	Residual: 35

Dependent Variable: TEXUS	Region: Middle East			Number of Cases: 30
Independent Variables	Simple r	β	B	Standard Error of B
VOTEUS	.72	0.48	22.90	6.71
GDP_i	.48	0.64	0.10	0.03
POP_i	-.02	-.47	-0.20	8.40
Constaot			-490.67	

Multiple R: .81	Standard Error: 257.39	Degrees of Freedom
Multiple R^2: .67	F-level: 15.01	Regression: 3
	Significance: p<.01	Residual: 22

Dependent Variable: TEXUS	Region: Africa			Number of Cases: 34
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.51	0.56	0.10	0.27
VOTEUS	.18	0.29	7.43	3.78
Constant			-48.63	

Multiple R: .58	Standard Error: 224.89	Degrees of Freedom
Multiple R^2: .34	F-level: 8.23	Regression: 2
	Significance: p <.01	Residual: 31

TABLE 8 (Cont'd)

Dependent Variable: TEXSU	Region: Europe			Number of Cases: 34
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.45	0.75	0.02	0.003
VOTESU	.05	0.24	15.79	8.67
Constant				
Multiple R: .71	Standard Error: 796.72			Degrees of Freedom
Multiple R^2: .50	F-level: 16.07			Regression: 2
	Significance: p <.01			Residual: 31

Dependent Variable: TEXSU	Region: Middle East			Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
POP_i	.81	1.10	8.35	1.35
GDP_i	.49	-0.36	-0.001	0.0004
Constant			-5.85	
Multiple R: .85	Standard Error: 41.12			Degrees of Freedom
Multiple R^2: .72	F-level: 28.82			Regression: 2
	Significance: p <.01			Residual: 22

Dependent Variable: TEXSU	Region: Latin America			Number of Cases: 30
Independent Variables	Simple r	β	B	Standard Error of B
POP_i	.69	0.70	0.36	0.06
SUGNP	-.32	-0.35	-0.19	0.00
Constant			10.59	
Multiple R: .78	Standard Error: 7.51			Degrees of Freedom
Multiple R^2: .60	F-level: 20.90			Regression: 2
	Significance: p <.01			Residual: 27

Dependent Variable: TEXSU	Region: Africa			Number of Cases: 37
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.60	0.89	0.0055	0.002
POP_i	.49	-0.31	-0.22	0.23
Constant			-.92	
Multiple R: .61	Standard Error: 7.28			Degrees of Freedom
Multiple R^2: .38	F-level: 10.53			Regression: 2
	Significance: p <.01			Residual: 34

TABLE 8 (Cont'd)

Dependent Variable: TEXCH	Region: Europe			Number of Cases: 34
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.91	0.98	0.74	0.010
POP_i	.77	-0.07	-1.27	2.31
Constant			3.17	
Multiple R: .92	Standard Error: 125.70			Degrees of Freedom
Multiple R^2: .86	F-level: 85.83			Regression: 2
	Significance: P <.01			Residual: 31

Dependent Variable: TEXCH	Region: Middle East			Number of Cases: 27
Independent Variables	Simple r	β	B	Standard Error of B
POP_i	.40	0.40	0.49	0.22
Constant			4.48	
Multiple R: .40	Standard Error: 10.87			Degrees of Freedom
Multiple R^2: .16	F-level: 4.97			Regression: 1
	Significance: P <.05			Residual: 25

Dependent Variable: TEXCH	Region: Latin America			Number of Cases: 28
Independent Variables	Simple r	β	B	Standard Error of B
POP_i	.39	0.41	0.34	0.14
VOTECH	.30	0.32	0.54	0.28
Constant			-18.25	
Multiple R: .51	Standard Error: 17.65			Degrees of Freedom
Multiple R^2: .25	F-level: 4.44			Regression: 2
	Significance: P <.05			Residual: 25

Dependent Variable: TEXCH	Region: Africa			Number of Cases: 39
Independent Variables	Simple r	β	B	Standard Error of B
GDP_i	.13	0.13	0.65	0.0007
Multiple R: .13	Standard Error: 6.98			Degrees of Freedom
Multiple R^2: .01	F-level: 0.69			Regression: 3
	Significance: P >.05			Residual: 35

TABLE 9

Region-Specific Parameters for Four Regions on U.N. Voting Intensity

Dependent Variable: VOTR70	Region: Europe			Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
VOTR69	.99	0.98	1.01	0.026
GOVT1	-.26	-0.05	-0.16	0.071
ETOTA	-.27	-0.02	-0.0053	0.0066
CONFLT69	-.50	0.01	0.017	0.028
Constant			0.15	
Multiple R: .99	Standard Error: 1.68		Degrees of Freedom	
Multiple R^2: .99	F-level: 525.21		Regression: 4	
	Significance: p <.01		Residual: 20	

Dependent Variable: VOTR70	Region: Middle East			Number of Cases: 14
Independent Variables	Simple r	β	B	Standard Error of B
THL69	.92	.68	53.50	9.27
TRADOCH70	.73	.02	-3328.31	831.01
TRADR70	-.16	-0.88	-0.10	0.03
TRADOSU70	-.02	0.83	605.21	165.47
VOTR69	.30	-.85	-12.99	4.23
Constant			905.14	
Multiple R: .90	Standard Error: 26.02		Degrees of Freedom	
Multiple R^2: .82	F-level: 7.68		Regression: 5	
	Significance: p <.01		Residual: 8	

Dependent Variable: VOTR70	Region: Latin America			Number of Cases: 20
Independent Variables	Simple r	β	B	Standard Error of B
GDPOP70	.55	0.72	0.16	0.005
TRADOSU70	-.29	-0.31	-492.79	306.99
GOVT5	-.995	.18	0.27	0.32
TRADOUS70	.08	.15	0.88	1.09
Constant			34.53	
Multiple R: .71	Standard Error: 4.93		Degrees of Freedom	
Multiple R^2: .50	F-level: 3.88		Regression: 4	
	Significance: p <.05		Residual: 15	

Dependent Variable: VOTR70	Region: Africa			Number of Cases: 21
Independent Variables	Simple r	β	B	Standard Error of B
GOVT1	-.87	-1.11	-4.36	0.47
TRADR69	-.36	0.42	0.008	0.002
TRADOCH70	.29	0.15	94.27	53.50
TRADOUS70	.24	0.09	0.95	0.89
Constant			2.40	
Multiple R: .93	Standard Error: 4.59		Degrees of Freedom	
Multiple R^2: .87	F-level: 28.97		Regression: 4	
	Significance: p <.01		Residual: 16	

TABLE 10

Region-Specific Parameters for European
U.N. Voting with Superpowers

Dependent Variable: VOTGUS70 Region: Europe				Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
GOVT2	-.68	-0.59	-3.39	1.76
ITOTA	-.26	-0.29	-0.13	0.067
GOVT4	.15	0.09	0.87	1.46
TRADGSU	-.64	-0.19	-6.59	9.93
Constant			40.93	
Multiple R: .76	Standard Error: 18.76			Degrees of Freedom
Multiple R^2: .58	F-level: 5.37			Regression: 5
	Significance: p <.01			Residual: 19

Dependent Variable: VOTGSU70 Region: Europe				Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
GOVT2	.78	0.65	4.76	1.13
TRADGCH70	-.56	-0.22	-410.85	290.67
ITOTA	-.08	-0.08	-0.05	0.07
Constant				
Multiple R: .80	Standard Error: 21.13			Degrees of Freedom
Multiple R^2: .64	F-level: 12.76			Regression: 3
	Significance: p <.01			Residual: 21

Dependent Variable: VOTGCH71 Region: Europe				Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
TRADGCH70	-.47	-0.63	-433.03	144.27
GOVT5	-.03	-0.28	-1.24	0.98
ITOTA	-.10	-0.23	-0.05	0.04
TRADGUS70	-.07	0.20	4.92	5.05
Constant			20.61	
Multiple R: .56	Standard Error: 11.05			Degrees of Freedom
Multiple R^2: .32	F-level: 2.35			Regression: 4
	Significance: p >.05			Residual: 20

TABLE 10

Region-Specific Parameters for Middle Eastern U.N. Voting with Superpowers

Dependent Variable: VOTEUS70	Region: Middle East			Number of Cases: 14
Independent Variables	Simple r	β	B	Standard Error of B
RELA1D69	.80	0.08	0.26	0.07
ARMEUS70	.65	0.41	8.59	3.05
TRADEUS70	.80	0.65	32.68	11.98
GOVT4	.000	-0.27	-1.07	0.66
Constant			4.26	
Multiple R: .93	Standard Error: 4.64			Degrees of Freedom
Multiple R^2: .86	F-level: 14.40			Regression: 4
	Significance: p <.01			Residual: 9

Dependent Variable: VOTEUS70	Region: Middle East			Number of Cases: 14
Independent Variables	Simple r	β	B	Standard Error of B
TRADEUS70	-.78	-0.53	-27.02	11.42
TRADECH70	.61	.36	256.29	112.00
GOVT3	.49	.17	0.36	0.07
RELA1D69	-.69	-.10	-0.03	
Constant			64.52	
Multiple R: .89	Standard Error: 5.64			Degrees of Freedom
Multiple R^2: .80	F-level: 9.19			Regression: 4
	Significance: p <.01			Residual: 9

Dependent Variable: VOTECH71	Region: Middle East			Number of Cases: 14
Independent Variables	Simple r	β	B	Standard Error of B
TRADEUS	-.78	-1.27	-24.36	5.79
GOVT5	-.14	-0.43	-0.40	0.15
GOVT4	.07	0.43	0.65	0.26
RELA1D69	-.72	0.33	0.04	0.03
Constant			85.72	
Multiple R: .91	Standard Error: 1.92			Degrees of Freedom
Multiple R^2: .84	F-level: 11.92			Regression: 4
	Significance: p <.01			Residual: 9

TABLE 10

Region-Specific Parameters for Latin American U.N. Voting with the Superpowers

Dependent Variable: VOTEUS70	Region: Latin America			Number of Cases: 21
Independent Variables	Simple r	β	B	Standard Error of B
GOVT2	-.58	-0.56	-3.30	1.10
GOVT5	.27	0.21	0.68	0.63
TRADOCH70	.22	0.28	15780.34	10896.38
GOVT3	-.11	-0.22	-0.59	0.53
Constant			16.06	
Multiple R: .69	Standard Error: 10.39			Degrees of Freedom
Multiple R^2: .47	F-level: 3.63			Regression: 4
	Significance: p<.05			Residual: 16

Dependent Variable: VOTOSU70	Region: Latin America			Number of Cases: 21
Independent Variables	Simple r	β	B	Standard Error of B
GOVT2	.77	0.79	6.04	1.04
TRADOSU70	-.27	-0.35	-1483.04	666.55
TRADOCH70	.01	0.26	19047.16	10778.59
RELAID69	.01	0.24	0.14	0.09
Constant			82.01	
Multiple R: .84	Standard Error: 9.90			Degrees of Freedom
Multiple R^2: .71	F-level: 10.07			Regression: 4
	Significance: P <.01			Residual: 16

Dependent Variable: VOTOCH71	Region: Latin America			Number of Cases: 21
Independent Variables	Simple r	β	B	Standard Error of B
TRADOCH70	-.42	-0.61	-14991.93	5527.01
TRADOUS70	-.22	-0.32	-1.59	1.01
TRADOSU70	.02	0.23	538.21	322.73
Constant			33.24	
Multiple R: .57	Standard Error: 5.07			Degrees of Freedom
Multiple R^2: .33	F-level: 2.86			Regression: 3
	Significance: p <.05			Residual: 0.7

TABLE 10

Region-Specific Parameters for African U.N. Voting with the Superpowers

Dependent Variable: VOTEUS70	Region: Africa			Number of Cases: 28
Independent Variables	Simple r	β	B	Standard Error of B
ARMEUS70	.27	0.21	8.89	7.93
TRADESU70	-.23	-0.26	-213.93	165.67
GOVT1	-.19	-0.22	-1.11	0.95
GOVT2	-.20	-0.19	-1.36	1.30
Constant			8.21	
Multiple R: .44	Standard Error: 12.78		Degrees of Freedom	
Multiple R^2: .20	F-level: 1.43		Regression: 4	
	Significance: P <.05		Residual: 23	

Dependent Variable: VOTESU70	Region: Africa			Number of Cases: 28
Independent Variables	Simple r	β	B	Standard Error of B
GVT1	-.50	-0.41	-3.15	1.23
TRADESU	.35	0.24	321.99	217.29
TRADECH	.33	0.26	309.66	181.75
RELAID69	.33	0.20	0.24	0.19
Constant			8.37	
Multiple R: .67	Standard Error: 16.29		Degrees of Freedom	
Multiple R^2: .45	F-level: 4.71		Regression: 4	
	Significance: P <.01		Residual: 23	

Dependent Variable: VOTECH71	Region: Africa			Number of Cases: 28
Independent Variables	Simple r	β	B	Standard Error of B
GOVT1	-.46	-0.45	-1.86	0.72
ARMEUS70	-.14	-0.19	-6.47	5.99
GOVT2	.20	0.15	.87	0.99
TRADECH70	.21	0.15	92.18	108.66
Constant			10.86	
Multiple R: .55	Standard Error: 9.72		Degrees of Freedom	
Multiple R^2: .30	F-level: 2.51		Regression: 4	
	Significance: p <.07		Residual: 23	

TABLE 11

Region-Specific Parameters for Four Regions
for the Defense Sector

Dependent Variable: DEFX70	Region: Europe			Number of Cases: 24
Independent Variables	Simple r	β	B	Standard Error of B
GDP70	.96	0.87	4.36	50.10
CONFLT69	.77	0.36	56.18	38.64
ERIVDEFX	.63	-0.30	-9.50	6.55
Constant			147.18	162.50
Multiple R: .97	Standard Error: 629.04			Degrees of Freedom
Multiple R^2: .94	F-level: 107.71			Regression: 3
	Significance: p <.001			Residual: 21

Dependent Variable: DEFEX 70	Region: Latin America			Number of Cases: 19
Independent Variables	Simple r	β	B	Standard Error of B
EMILA	.91	0.92	39.44	4.09
TML	-.11	-0.14	-21.74	15.04
Constant			-29.20	
Multiple R: 92	Standard Error: 102.27			Degrees of Freedom
Multiple R^2: 85	F-level: 47.06			Regression: 2
	Significance: p < [illegible]			Residual: 16

Dependent Variable: DEFX70	Region: Middle East			Number of Cases: 15
Independent Variables	Simple r	β	B	Standard Error of B
MILA10SM	.63	0.52	0.63	0.27
CONFLT69	.66	0.59	332.42	127.07
ERIVDEFX	.31	-0.29	-1.29	1.07
Constant			-35.73	
Multiple R: .79	Standard Error: 283.03			Degrees of Freedom
Multiple R^2: .64	F-level: 6.14			Regression: 3
	Significance: p <.01			Residual: 11

Dependent Variable: DEFX70	Region: Africa			Number of Cases: 16
Independent Variables	Simple r	β	B	Standard Error of B
CONFLT69	.71	0.70	311.76	47.24
GDPOP70	.48	0.47	0.30	6.88
Constant			-115.60	22.77
Multiple R: .85	Standard Error: 56.78			Degrees of Freedom
Multiple R^2: .73	F-level: 31.93			Regression: 2
	Significance: p <.001			Residual: 24

TABLE 11 (Cont'd)

Dependent Variable: MILMAN70 Region: Europe				Number of Cases: 24
Independent Variables	Simple r	β	B	Standard Error of B
POP70	.91	1.12	0.11	1.69
DEFX69	.71	-0.29	-223.93	203.55
CONFLT69	.47	0.19	2.10	5.14
ERIVDEFX	.37	-0.14	-3347.79	8463.46
Constant			0.32	
Multiple R: .92	Standard Error: 0.76		Degrees of Freedom	
Multiple R^2: .84	F-level: 26.64		Regression: 4	
	Significance: p <.001		Residual: 20	

Dependent Variable: MILMAN 70 Region: Middle East				Number of Cases: 15
Independent Variables	Simple r	β	B	Standard Error of B
CONFLT 69	.42	0.01	0.15	0.34
DEFGDP 70	.41	0.02	0.24	0.36
IMILAID	.92	0.03	.0005	0.0006
ΔDEFX (68-69)	.55	-0.02	-.0002	0.0003
MILMAN 69	.99	0.96	1.07	0.05
Constant			-.06	
Multiple R: .99	Standard Error: .05		Degrees of Freedom	
Multiple R^2: .99	F-level: 765.59		Regression: 5	
	Significance: p<.01		Residual: 9	

Dependent Variable: MILMAN 70 Region: Latin America				Number of Cases: 19
Independent Variables	Simple r	β	B	Standard Error of B
DEFX 69	.98	1.02	0.43	0.17
GDPGP 70	.14	-0.14	-0.43	0.12
Constant			0.21	
Multiple R: .99	Standard Error: .12		Degrees of Freedom	
Multiple R^2: .97	F-level: 352.89		Regression: 2	
	Significance: p<.01		Residual: 16	

Dependent Variable: MILMAN70 Region: Africa				Number of Cases: 26
Independent Variables	Simple r	β	B	Standard Error of B
MILMAN69	.95	0.67	1.08	0.100
CONFLT69	.83	0.26	0.42	0.100
DDEFX	-.74	-0.15	-0.004	0.002
Constant			-0.12	
Multiple R: .98	Standard Error: 0.08		Degrees of Freedom	
Multiple R^2: .96	F-level: 180.13		Regression: 3	
	Significance: p <.01		Residual: 22	

TABLE 12

Region-Specific Parameters for Domestic Conflict

Dependent Variable: IRVLT	Region: Europe			Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
ITML	.56	0.50	1.69	0.62
IRVLT	.25	0.22	0.15	0.12
CONFL69	.29	0.15	2.06	2.51
Constant			0.18	
Multiple R: .61	Standard Error: 1.81		Degrees of Freedom	
Multiple R^2: .37	F-level: 4.17		Regression: 3	
	Significance: p <.05		Residual: 21	

Dependent Variable: TML70	Region: Europe			Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
TML69	.48	0.31	0.38	0.24
TRADOUS70	.30	0.51	0.39	0.19
DEFGDP70	.14	0.40	5.27	3.26
Constant			-0.37	
Multiple R: .60	Standard Error: 0.34		Degrees of Freedom	
Multiple R^2: .36	F-level: 3.90		Regression: 3	
	Significance: p <.05		Residual: 21	

Dependent Variable: Turmoil 70	Region: Developing			Number of Cases: 60
Independent Variables	Simple r	β	B	Standard Error of B
COUPS (56-65)	.27	0.11	0.26	.20
DEFGDP 70	-.08	-0.08	-4.43	5.16
EMILAID	-.05	0.04	0.28	0.62
TML 69	.74	0.72	0.84	0.10
Constant			-0.074	
Multiple R: .76	Standard Error: 1.47		Degrees of Freedom	
Multiple R^2: .57	F-level: 18.94		Regression: 4	
	Significance: p<.01		Residual: 55	

Dependent Variable: COUP(61-65)	Region: Developing			Number of Cases: 34
Independent Variables	Simple r	β	B	Standard Error of B
TRADGP (56-69)	.60	0.57	0.76	.14
TML 65	.45	0.43	0.14	.04
DEFGDP (61-65)	-.26	-0.13	-0.0034	.0004
EMILA (60-64)	.05	-0.07	-0.0015	.0044
Constant			.22	
Multiple R: .75	Standard Error: .33		Degrees of Freedom	
Multiple R^2: .57	F-level: 9.57		Regression: 4	
	Significance: p<.01		Residual: 29	

TABLE 13

Region-Specific Parameters for Four Regions
on International Conflict

Dependent Variable: CONFLT70 Region: Europe				Number of Cases: 25
Independent Variables	Simple r	β	B	Standard Error of B
CONFLT60	.87	1.57	0.17	0.035
RIVDEFX	.76	-0.74	-0.0002	0.0000
Constant			0.52	
Multiple R: .89	Standard Error: 0.80		Degrees of Freedom	
Multiple R^2: .80	F-level: 46.26		Regression: 2	
	Significance: p < 01		Residual: 22	

Dependent Variable: CONFLT70 Region: Latin America				Number of Cases: 19
Independent Variables	Simple r	β	B	Standard Error of B
CONFLT69	.54	0.73	0.40	0.097
DDEFEX70	.36	0.62	0.0017	0.0005
DEFGDP70	.03	-0.47	-7.33	3.05
Constant			0.23	
Multiple R: .78	Standard Error: 0.11		Degrees of Freedom	
Multiple R^2: .60	F-level: 7.61		Regression: 3	
	Significance: p <.01		Residual: 15	

Dependent Variable: CONFLT70 Region: Middle East				Number of Cases: 14
Independent Variables	Simple r	β	B	Standard Error of B
CONFLT69	.95	0.98	1.08	0.14
DEFEX70	.51	-0.19	-0.0004	0.0002
SPCOOP70	.78	0.13	0.03	0.03
Constant			.27	
Multiple R: .97	Standard Error: 0.22		Degrees of Freedom	
Multiple R^2: .94	F-level: 53.79		Regression: 3	
	Significance: p <.01		Residual: 10	

Dependent Variable: CONFLT70 Region: Africa				Number of Cases: 27
Independent Variables	Simple r	β	B	Standard Error of B
SPCOOP70	.86	9.90	0.24	0.46
DEFGDP70	.59	0.20	3.01	1.62
CONFLT69	.64	-0.16	-0.15	0.14
Constant			0.42	
Multiple R: .89	Standard Error: 0.10		Degrees of Freedom	
Multiple R^2: .79	F-level: 28.93		Regression: 3	
	Significance: p <.01		Residual: 23	